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The Copper Handbook.

By
Horace J. Stevens,
Houghton, Mich.

1900.

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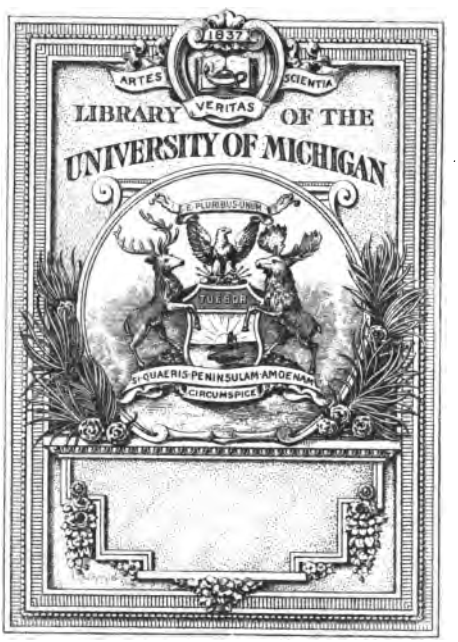

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The Copper Handbook.

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GIVING FIFTY STATISTICAL TABLES, THOROUGHLY COVERING LAKE SUPERIOR COPPER PRODUCTION, VALUES, PRICES, DIVIDENDS AND ASSESSMENTS; THE CAPITALIZATION, FLUCTUATIONS IN PRICES AND TRANSFERS OF SHARES OF LAKE SUPERIOR COPPER COMPANIES; COPPER PRODUCTION, CONSUMPTION AND EXPORTS OF THE UNITED STATES; THE ENGLISH COPPER TRADE; THE WORLD'S COPPER PRODUCTION, AND OTHER TABLES;

ALSO,

DETAILED DESCRIPTIONS OF ALL LAKE SUPERIOR COPPER MINES, SHOWING LOCATION, AREA, OFFICIALS, PRODUCTION, LODES, SHAFTS, MACHINERY, MILLS, RAILROADS, BUILDINGS, FORCES, COPPER PERCENTAGES, AND MUCH OTHER INFORMATION OF VALUE.

COMPILED AND PUBLISHED BY

HORACE J. STEVENS,

HOUGHTON, MICHIGAN.

1900.

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Preface.

This little volume was originally planned nearly six years ago. As material was gathered the scope of the work was enlarged, and as now published the book represents an amount of labor entirely disproportionate to its modest size. As the Copper Handbook is intended as a work of reference rather than a racy description of copper mines, two objects have been held steadily in view in its preparation, the first of these being accuracy, and the second brevity. The information given regarding the mines, the metal and copper mining shares, has been condensed to the utmost point consistent with clarity.

While the most painstaking effort has been made to verify every fact and every figure contained in this book, no volume has yet been printed absolutely free from error since Guttenberg invented movable types. The Author will cordially welcome any correction of fact or figure from any source, and will thankfully receive any suggestions looking toward the improvement of later editions, which it is now intended to issue annually, bringing all statistics down to date, and incorporating additional information secured from year to year.

HORACE J. STEVENS.

Houghton, Mich., Sept. 29, 1900.

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Historical

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Historical.

Nature and man have joined in making the State of Michigan in two very distinct sections, divided by water and unlike in climatic and industrial conditions. That there have been frequent misunderstandings between the two sections is fortunate for neither, for united they are and must remain, and better mutual acquaintance with the resources and needs of each will do much to set at rest the bickerings that have been due to misunderstanding rather than malice.

In the early days of the Territory of Michigan, the people of Ohio, already a state in the earlier decades of the century now closing, were despoiled—or at least they so believed—of the richest portion of their lands. The State of Ohio claimed a portion of the land formerly accredited to the Territory of Michigan, and Ohio being a state, with senators and representatives of influence at Washington—for Ohio has been prolific of statesmen from even its earliest days—the State won and the Territory lost. There was much talk of war and revenge by the bellicose inhabitants of the Territory, but the talk came to nothing in the way of bloodshed, and the disputed section, which is now the County of Lucas, including within its borders the City of Toledo, was detached forcibly from the indignant Territory of Michigan and affixed to the State of Ohio, where the expansion sentiment was then strong. The scar still remains, as an inspection of the map will show, the southeastern boundary of the State of Michigan showing the jagged notch made by the political surgery of seventy years ago.

To appease the indignant residents of the territory, which already had aspirations toward statehood, the administration at Washington offered to throw in what is now the Upper Peninsula of Michigan, detaching the district from the Territory of Wisconsin, which was too young, and too busily occupied with buying peltry and watching hostile Indians, to care for the loss of a trifle like eighteen thousand square miles of land. Michigan refused the proffer, but it was thrust upon the Commonwealth when the state was erected from a territory.

The territory so gained was regarded as of little value by the white population of the state. It was looked upon as a sort of undesirable bantling left upon the door-step, which motives of common humanity compelled caring for, but for which neither human nor divine law could reasonably demand affection. The northern peninsula was inhabited by the Chippewa Indians, with a few scattered fur traders.

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Copper was known to exist there, thanks to the explorations of the Jesuits, in the seventeenth and eighteenth centuries, but no attempts were made to turn the knowledge to profitable use until the efforts of Dr. Douglass Houghton resulted in the appropriation of a small sum for the exploration of the terra incognita. Until his discoveries had changed the popular estimate, the Upper Peninsula was regarded by residents of Michigan as a sort of undesirable back-yard, filled with all kinds of rubbish, but which was fortunately surrounded by so high a fence that few of the neighbors could peek inside. To Dr. Houghton the entire state, and more especially the Upper Peninsula, owes a debt of gratitude which can never be repaid, but which should at least find expression in a suitable monument.

Dr. Houghton, who was a scientist of high ability and a man of exceptionally fine mental poise, made his first visit to the southern shore of Lake Superior in the summer of 1830, in company with General Lewis Cass, then and for some years later the foremost citizen of the state. General Cass, though an able man, was not highly impressed by the value of the Northern Peninsula, seeing only the rugged hills with their verdure of pine and maple, but Dr. Houghton, who combined the attainments and exact knowledge of the scientist with the ability to plan and to dream dreams which came true, was much taken with the wilderness, and his prophetic eye saw arising upon the shore of the greatest fresh-water sea of the globe those thriving cities which, though now but yet in their infancy, far surpass what even Detroit became during the lifetime of General Cass or himself.

Dr. Houghton repeated his visit in the following summer, and then made the determination to give the southern shore of Lake Superior the thorough topographical and geological examination that was a necessary preliminary to its successful exploration. Despite his high standing in the state, where he had been mayor of Detroit, and could have gained higher political honors had he preferred them to his work afield, Dr. Houghton spent several years in laboring with successive legislatures before he was able to secure the niggardly appropriation finally granted for a survey of the Upper Peninsula. Selecting with rare skill a small but capable staff of assistants, Dr. Houghton plunged into the wilderness with his little party. Their work was done rapidly but well, much as a great artist sketches the outlines of a beautiful face with a few strong strokes of the pencil. Owing to the immense territory to be covered and the pitifully meagre sum at his command, Dr. Houghton did not attempt the minute work accomplished by those who have followed in his footsteps, but the bold outlines then sketched by him and his devoted little band of scientist-explorers have been found true in every detail. He blazed the trail which later generations have followed in ever-increasing force, but his work was so thoroughly done that it has never required doing a second time. Others have furnished the details, but the plan was his. Of the assistants employed by Dr.

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Houghton in this work in the third and fourth decades of the century, one is yet living, Jacob Houghton, of Detroit, a younger brother of the leader of the party.

Dr. Houghton's first report was not printed until 1841, but it excited immediate interest. Previous stories of mineral wealth on the southern shore of Lake Superior had been too vague and confused to interest capitalists sufficiently to venture their money in attempts at mining in a country which was then much farther from centers of wealth and population than is Cape Nome today, measured by time and transportation facilities. This apathy was dispelled by Dr. Houghton's first report, which was clear and concise, and bore upon its face the stamp of truth. He told the world that vast stores of copper existed upon the southern shore of Lake Superior. Pressure was brought to bear upon the Federal government, and in 1843 an arrangement was concluded with Dr. Houghton by which he was to combine a linear survey for the United States with the topographical and geographical survey he was then making for the State of Michigan. It was necessary that this linear survey be made before mining locations could be granted by the Federal authorities, as there were no boundaries other than those of nature before that time. The work was begun in 1844, and during that and the following year rapid progress was made. Dr Houghton's career was brought to an untimely end by his accidental drowning in Keweenaw bay in the late fall of 1845, but his work was then so far advanced that it was taken up and pushed to early completion by competent successors.

Previous to the beginning of the linear survey, title had been quieted by securing the session from the Chippewas of nearly 30,000 square miles on the southern shore of Lake Superior. The tract so secured in 1842 stretched from Sault St. Marie, on the outlet of Lake Superior, to the St. Louis River, at the head of the lake, including the sites of the present cities of Duluth and Superior. The lands so ceded—and which have never been fully paid for—are probably worth nearly a billion dollars today.

The first mining permits were issued by the government in 1844. In the same year Dr. Houghton's assistants first discovered iron ore, on property now owned by the Jackson Iron company, at Negaunee. The first copper mining permits were for nine square miles each; but this area was soon reduced to one square mile. A royalty of 20 per cent on the gross production was demanded by the government. The system did not work well; permits were issued in a happy-go-lucky way, and any promising show of metal speedily brought forth a number of claimants. The 20 per cent royalties were not forthcoming, because the first miners contented themselves with hunting for stray masses of copper on surface, and few of these paid toll at the government gate. In 1846 the plan of permits was abolished, and all mineral lands were placed on the market at the uniform price of $5 per acre, reduced shortly thereafter to $1.25 per acre; owners of registered claims

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being given the first opportunity of purchasing lands so held, or such portion of them as might be desired. It is from the time when full titles were first given that actual copper mining in the Upper Peninsula can be dated. The Pittsburg & Boston Mining Company was organized in 1844, begun mining on a fissure vein in Keweenaw county in 1846, and paid its first dividend in 1849. The mine of this company, known as the Cliff, was the first copper mine opened in the Lake Superior district since the pre-historic days of the mound-builders, and the first mine to pay a dividend from Lake Superior copper. In the half century that has followed, a hundred millions of dollars have been paid in profits by Lake Superior copper mines.

Since the year 1850 the progress of the iron and copper mining industries has been comparatively steady. There have been times of depression and periods of boom, but from decade to decade steady and substantial progress has been shown by both industries. A peculiar feature of mining in this State has been, that as a rule, the copper mines have been most prosperous when times were dull with iron, and *vice versa*. There have been exceptions to this rule, as during the panic periods of 1873 and 1893, when both industries were hit by the prevalence of national depression, yet it can scarcely be said that the hard times of 1893-98 were felt in the Michigan copper district. The mines reduced wages 10 per cent in October, 1893, but this cut was restored less than a year later, and the decrease in the prices of nearly all commodities was so marked that the employes of the copper mines were enabled to live in their usual manner and yet save fully as much money as before, during the few months of reduced wages.

While the iron mines of Lake Superior are located in three states of the Union, with at least two important ranges (the Michipicoten and Atikokan) in Canada, to the north of the great lake, the Lake Superior copper district lies wholly in Michigan, at least as far as producing mines are concerned; though there is no question that the Keweenawan trap formation, carrying native copper, extends through the entire northern part of Wisconsin and into the state of Minnesota, with an easterly outcrop in Canada, on the north shore of the lake. A limited amount of development work is under way in Douglas County, Wisconsin, but the producing mines of the district are as yet located exclusively in the three Michigan counties of Houghton, Keweenaw and Ontonagon.

The Lake Copper District is in many respects the most interesting mining field of the world. Its annual profits are greater than those of any other mining district, with the exception of the Witwatersrand, in South Africa, when active. The profits of the great Calumet & Hecla are the largest earned by any mine, and it is also the deepest mine in existence, although this honor will soon be taken by the Tamarack, the Calumet & Hecla's nearest neighbor, which is sinking a shaft that is to be a full mile in depth.

A volume, and a most entertaining one at that, might be written

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upon the early history of the copper country. The literature of the geology of the district comprises many volumes treating of mining as a whole, and monographs, most of which are of great value and decided interest. There are single mines regarding which other volumes have been written. A mere skeletonized history of the Calumet & Hecla, unembellished with grammatical flourishes, would make a large book. A complete summary of the matters of interest relating to the district and its mines would require a lifetime to write, and would be of encyclopædic proportions when printed.

In the way of romance, the copper mines would furnish themes for a score of clever writers. The discovery by poor men of fortunes rivalling those of fable; the materialization of the great Tamarack Mine from the dream of a man called, in derision, "the crazy Cornish miner;" the silver treasures of the Cliff, Minnesota, and other mines of early days; the adventures of the pioneers; the evidences of mining by prehistoric races; the many terrifying accidents and hair-breadth escapes in the depths of the earth—all this and much more gives a tinge of romance to the ordinarily prosaic business of mining.

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Miscellaneous

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Miscellaneous.

Specific Taxation.

It is seriously proposed to revive the specific tax on iron ore and copper by the State of Michigan. This tax was abolished in 1891, and the mines have since been assessed and taxed for state, county and municipal purposes precisely like any other property. The specific tax was an unjust one, and it is beyond the ingenuity of man to devise any plan of specific taxation that will prove equitable. If the mines ought to pay a fixed tax on every ton of ore and every pound of copper produced, by analogy the farmer should pay a fixed tax on every ton of hay, bushel of potatoes and statutory measure of other crops produced; the merchant should pay a fixed percentage on sales, and the railroads a similar specific tax on ton-miles for freight hauled, and passenger-miles for persons transported. Were this plan of specific taxation universally applied, its lack of equity would speedily become apparent. One farmer can raise two and a half or three tons of hay to the acre, while his neighbor, using an equal amount of land and labor, can average but a single ton. Some favored fields in Michigan yield 300, 400 and even 500 bushels of potatoes to the acre, while other lands give much smaller returns. A specific tax on products would bear down heavily on the poor farms. So with the railroads; the great trunk line could easily pay a specific tax per ton-mile that would crush the struggling branch-line engaged in opening a new territory. A heavy specific tax of a certain percentage on sales could be easily borne by the dealer in furs or diamonds, but it would stagger the grocer who sells flour, sugar and other staples at a very small advance over cost.

There is one excellent reason why the specific tax should not be applied to the copper mines, and two good reasons why the tax would be unjust if levied on the iron mines. With copper selling at 16⅝ cents per pound, as at this writing, in August, 1900, some Michigan mines are netting 100 per cent on the cost of their metal, while others are making 50 per cent, yet others 25 per cent; some are lucky to get a new dollar for an old one, and a few are producing copper costing more than it can be sold for. It is essentially unjust that the Calumet & Hecla, mining rock returning nearly 3½ per cent pure copper, should pay no larger tax per pound on its product than the Atlantic, which secures an average of less than ¾ of one per cent ingot from its rock. Neither would it be possible to arrange an equitable sliding scale according to the richness of the rock, because one mine with rock averaging only 1

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per cent copper may easily prove more profitable than a neighboring mine averaging fifty per cent richer in metal, by reason of the mine with the lower percentage having a larger lode and rock more easily broken and stamped. A specific tax based on production would also be unjust. The Atlantic and Wolverine are under the same management, and producing about the same amount of copper annually, yet the Wolverine rock is twice as rich in copper as the Atlantic's, with profits to correspond.

With the iron mines, all that has been written of copper in the preceding paragraph also holds good, in addition to which the iron ore mined in Michigan varies remarkably in price. The published prices of ore sales are for ore delivered at Lake Erie ports, 600 to 900 miles from the mines. Deducting the cost of rail and lake freights from the Cleveland prices, it will be found that Michigan ores for the season of 1899 and 1900 have netted producers all the way from 25 cents to $3 per ton, at the mines, from which prices must be further deducted the actual cost of mining. A specific tax which might be little felt by the rich mines would close some of the smaller properties. There are single mines producing as many as five different grades of ore, varying greatly in chemical constitution and commercial value.

The only equitable basis on which to assess mining property in Michigan is that of actual value, precisely as other property is assessed. Discrimination between different kinds of property is essentially inequitable. All should bear their burden of taxation according to value, and in no other way.

Mining Companies Not Tax Dodgers.

The charge has been made, by persons and newspapers totally devoid of knowledge of the real situation and facts, that the upper peninsula mines are dodging taxation. Nothing could be further from the truth. The county of Houghton stood third in equalized value in the state in 1899, being assessed at but $2,500,000 less than Kent County, containing the city of Grand Rapids, which is the largest furniture manufacturing center in the world, with a population of 100,000. The supervisors of Houghton County took the unprecedented step, ten years ago, of assessing the county on the basis of the actual market prices of its copper mining shares, and this was the only county in the state to turn in an actual cash valuation. So high were the figures that they were considered excessive by the state board of equalization, and reduced several million dollars. No other county in Michigan has ever had the valuation returned by its officials reduced because excessive. In view of this action, taken voluntarily ten years ago, the charge of tax-dodging is not only totally lacking in foundation, but cruelly unjust as well.

The assessed value of Houghton County was placed at $42,000,000 by the state board of equalization five years ago, on the returns of the

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county board. At that time the figure named was practically a cash valuation. Since then a boom of unparalleled proportions has boosted prices of Michigan copper mining shares to previously undreamed-of figures, though the present range of prices is considerably below the high water mark of 1899. Five years ago Calumet & Hecla stock was worth less than $300 per share, or at the rate of $30,000,000 for the mine. It has since sold at $895 per share, or at the rate of $89,500,000 for the mine—more than three times the price of five years ago—and at present is worth about $750 per share. Tamarack, Quincy, Osceola and other shares have also made great advances in the past few years.

Present Assessed Valuation of Houghton County.

The State Tax Commission of Michigan, a body created in 1899 with revisionary and assessing powers of large scope, held sessions in Houghton on Sept. 14 and 15, 1900. As a result of the meeting the assessed valuation of Houghton county was raised to the very large sum of $122,491,521, an increase of $39,491,521 over the figures of the county board of supervisors. Of this increase of nearly forty million dollars, all but a few hundred thousand dollars was on the copper mines, the assessed valuation of 23 mines being reviewed, and in every case materially increased by the state board.

Capitalization of Mining Companies.

One feature of the prices of copper shares that proves confusing to those but little acquainted with the matter is the capitalization. Many people hold the impression that when a mining company is capitalized for 100,000 shares having a par value of $25, the shares must be worth par, and should pay taxes on that basis of value. Nothing could be further from the truth. The Wyandot and the Calumet & Hecla copper mining companies are each capitalized for the same amount—$2,500,000—yet Wyandot at present market price is worth but $150,000 for the entire property (which cost $800,000), while Calumet & Hecla is worth $75,000,000. Other copper mining companies capitalized at one million to two and a half millions each are practically worthless, their shares having no market at any price. The capitalization of mining companies is nominal. The law of Michigan requires that the par value of the shares of all mining companies incorporated under its laws shall be $25, and the largest number of shares allowed is 100,000, giving a possible maximum capitalization of $2,500,000, of which all or a mere fraction may be paid in, in cash, realty or personal property. The earlier mining companies had only 3,000 shares each. This was followed by companies having 10,000, then 20,000, later 40,000, afterward 50,000 or 60,000, and finally 100,000 shares. Practically all of the newly incorporated companies have taken the maximum of 100,000 shares. It would be decidedly in the interest of the investing public if laws could be secured for the entire country, by which all mining corpora-

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tions would be given a uniform number of shares. It would make no practical difference whether this number were one hundred thousand or one million, but if uniformity were secured purchasers would know that they were buying a fixed proportion of the whole mine with every share secured. As it is now, many investors have very hazy notions on this point, believing that a share is a share, and that there is nothing more to the matter. It makes a difference, however, whether that single share is in the Calumet & Hecla and worth $750, or in some wildcat western mine capitalized with one to five million shares, with its stock sold by the thousand, like cull lumber, at prices only properly expressible in Brazilian currency, where it takes one thousand milreis to make a dollar—and that dollar a silver one.

The Calumet & Hecla company has been severely and most unjustly censured, because its capitalization is but $2,500,000, while the value of its property is actually thirty times that sum. If the Calumet & Hecla were to reincorporate under the laws of some other state, a great protest would be made, yet the company has taken the largest capitalization allowed under the statutes of Michigan. A bill was introduced at the last session of the state legislature providing for an increase of 50 per cent in the maximum capitalization allowed mining corporations, yet this measure was roundly denounced by certain members of the legislature as covering some bunco scheme, not clearly understood but certainly concealed somewhere, by which the mining companies would be enabled somehow to defraud the state, their creditors and the public generally. The direct result of the defeat of that bill has been the reincorporation of two Michigan mining companies, the Isle Royale and Arcadian, under the laws of New Jersey. It was deemed necessary by the managements of these companies to increase their capital stock, in order to take in adjoining territory which was highly desirable, and indeed necessary, for the future welfare of the mines named. The state of New Jersey received from these two corporations the sum of $3,750, which would have been given the state of Michigan had the bill permitting increased capitalization been passed as introduced. A too stringent policy regarding the incorporating of new companies and the reincorporation of old companies may deprive Michigan of income to which the state is justly entitled, and do this without securing a single compensating advantage.

General Prosperity in the Copper District.

The year 1899 was the most prosperous in the history of the Lake Superior Copper District, and this prosperity was shared in satisfactory degree by owners, employees and business interests dependent upon the mining industry. The extent of building operations and the increase of population in the copper country since the beginning of 1898 have been without parallel, and the business and labor conditions remain as good as at the height of the boom, even though speculative features are not so satisfactory as they once were.

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Copper Range Railroad.

The Copper Range Railroad, running from Houghton to Mass City, a distance of 41 miles, was built in 1899 and placed in operation early in 1900. This line has opened a vast territory, rich in mineral, timber and arable soil, which heretofore has lain in idleness because of inaccessibility. The completion of this line was an event of equal importance with the building of the first railroad between Houghton and Calumet, and with the advent of the first railroad connecting the copper district with the outside world. To the public spirit of the promoters and builders of the Copper Range Railway the people of the copper district owe a debt of gratitude.

Michigan College of Mines.

The Michigan College of Mines is a technical school of which the entire state may well be proud. It ranks with the University of Michigan, among the world's best and most famous institutions of higher education, Although founded but fourteen years ago, it already takes precedence of all similar schools in the United States, and has but a single rival among the mining colleges abroad. The school has been a subject of special solicitude to the best men of the iron and copper districts, from its inception, and has had the invaluable help of able mining men, who have freely given their time and effort without money and without price, in the desire to see the school made what it has already become—the leader of its class in the new world. The school has been favored with strong and energetic tutors, men of the highest professional standing—men like Prof. McNair, the present able president; Dr. Koenig, the discoverer of thirteen new minerals; Prof Seaman, the geologist, and others of marked ability in their respective lines of effort. The type of students has also been exceptionally high; almost invariably they are young men with matured plans for future careers, bent upon making the most of their opportunities, and withal men whose gentlemanly conduct is in marked contrast to the roystering seen in too many college towns. The College of Mines is located at Houghton, in the heart of the copper district, and within short distance of the great Marquette, Menominee and Gogebic iron ranges. It now has about 125 students, many from foreign countries, and its graduates are occupying responsible positions in almost every important mining field of the globe. Able tutors, earnest students, and a board of control composed of successful mining men, supplemented by the liberal aid given from the state, have combined to make this a singularly successful school. Its standing may be inferred from the many requests for graduates, from mines, not only in America but abroad. Practically all its graduates are "bespoken" before their diplomas are granted, and many applications for mining engineers, chemists and superintendents are not filled for lack of material. It is doubtful if there is another school anywhere which

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can place its graduates in responsible and lucrative positions as rapidly as they are turned out; the mere hall-mark of the Michigan College of Mines usually being sufficient to ensure a good berth immediately.

Portage Lake Waterways.

The general government is doing a vast amount of work on the Portage Lake waterways, and some of the largest vessels on the great lakes now make the ports of the copper district. Deeper and better channels mean a large annual saving to the mines on coal and other freights, and decreased cost of living to the 75,000 people directly dependent upon the Lake Superior copper mines for a livelihood.

Trend of Copper Developments.

The earlier development of mines on the Keweenaw peninsula was in districts, those of Ontonagon and Keweenaw counties receiving the first attention. A little later mines were opened in Houghton County, at Portage Lake. These latter gradually became more important, and the finding of the great Calumet & Hecla made Houghton county the largest producer of the three, some thirty years ago. From that time until the beginning of 1897 there was a gradual constriction of the limits of the active portion of the copper belt, by which Ontonagon and Keweenaw counties were practically eliminated from the field of producers. In 1897 there were but eight Michigan mining companies producing copper, and the active district was less than 20 miles in length, reaching from the Atlantic mine on the south to the Wolverine on the north. Since the organization of the Baltic company, late in 1897, the field of mining activity has stretched from the center in both directions, and now reaches from well toward the eastern end of Keweenaw Point to the western bank of the Ontonagon river, a distance of nearly seventy-five miles. Further extensions are not improbable, as the group of copper-bearing rocks extends both east and west of the present limits of mining.

Revival of Interest in Michigan Copper Mining.

Beginning with 1897, there has been a marked revival in copper mining, in the Lake Superior district. For the quarter century preceding that year the tendency had been toward the concentration of mining in a small territory, and the suspension of work at all outlying properties. The consolidation of the Huron, Grand Portage and Isle Royale mines, in Houghton, under the name of the latter, early in 1897, was quickly followed by the development of the Baltic mine, six miles south of the same town. The Adventure mine reorganization and consolidation followed shortly after, and in 1898 and 1899 work was resumed or begun at nearly thirty old and new mines. Several of

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these have stopped work, after using a small amount of money, but the greater number are still actively engaged in mining, with varying prospects of success. Of the older mines, the Isle Royale Consolidated can scarcely be regarded as an experiment, and there are others, such as the Mass Consolidated, having most excellent prospects. Among the absolutely new mines, so called in contra-distinction to the reorganized properties, the Baltic is now an active producer, and while not making good all the foolish promises made by overly enthusiastic friends two and three years ago, is doing even better than was anticipated by the best judges of Lake Superior copper mining. Other new mines, such as the Mohawk, Champion, and Trimountain, are showing marvelously rich ground, with bright prospects of future large and profitable production. The new mines will be considered, as well as the older properties, in the portion of the book following hereafter, in which the various mines and prospects are given individual mention.

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Geological.

Keweenawan Geology from a Lay Standpoint.

The geology of the Lake Superior Copper District is more readily comprehensible than that of the average mining field. Its outlines are so rapidly grasped that the very ease with which a knowledge of the main points may be secured is a source of danger to the writer or mine operator whose learning is not grounded upon practical experience. The exceptions to the rule are of about as much importance as the rules themselves in mining matters. For instance, the Calumet conglomerate is a strong, clearly defined reef, once the bed of a sea, stretching approximately northeast and southwest and dipping to the northwest at an average angle of 37½ degrees with the horizon. Where opened on the Calumet & Hecla property it is very rich in copper. From these data it would naturally be inferred that the extensions of the conglomerate to the north and south of the Calumet & Hecla property must be immensely valuable. Acting on such supposition, based on the soundest logic, the Osceola company purchased the southern extension of the lode and opened a rich mine thereon—but the lode was rich only in one small corner, and but for the development of a new mine on the parallel lode—now known as the Osceola amygdaloid—the Osceola company would have failed ignominiously. To the northward of the Calumet & Hecla the lode was secured by the Schoolcraft company, which lost much money trying to develop a paying mine thereon. The Centennial company then took the Schoolcraft lands and sunk nearly a million and a half dollars in attempting to open a paying mine on the conglomerate. The present reorganized Centennial company is devoting its attention to opening two parallel amygdaloid lodes, the Osceola and Kearsarge, and is letting the Calumet conglomerate severely alone, evidencing commendable wisdom in so doing.

The foregoing instances are but two among many, illustrating the danger of reasoning too speciously from given premises. Were it not for the exceptions to the rules, any sort of a man could go out of a morning and locate a profitable mine during the day. In the brief paragraphs following, the principal outlines of the geology of the district will be pointed out, but no attempt will be made to go into details or to render the explanation strictly technical.

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The formation carrying the cupriferous lodes and veins of the Lake Superior district is mainly composed of old lava flows, supplemented by belts of conglomerate formed by the deposition of rocks, broken from adjacent shores, over old sea-beds. This belt of Keweenawan rocks, so called from its predominance in the Keweenaw peninsula, where first noted by early geologists, is of considerable extent. It forms a trough, or synclinal, the southern edge outcropping on the Keweenaw peninsula and to the westward along the southern shore of the lake, and it is with this southern edge that we have to do. The other outcrop of the rock strata forming this trough is noted on Isle Royale, and on the northern shore of the lake for the greater part of its western half; also on the southern shore of Lake Superior in Douglas County, Wisconsin, where some mining is now being carried on in an exploratory way, and again on Michipicoten island and the adjoining northern shore, at nearly the extreme eastern end of Lake Superior. The axial line of the synclinal seems to run somewhat north of east, but there is marked diversity in the trend of the southern outcrop in Michigan, where mining is actively prosecuted, the strike ranging from nearly due east and west to North 30 degrees East in the Portage Lake district. Broadly speaking, Lake Superior rests in the trough of the Keweenawan series.

Discarding further consideration of the northern outcrop of the series, where the dip is to the southward, it may be said that the dip of all of the southern outcrop of the Keweenawan beds is to the northward or northwest.

The cupriferous strata on the Keweenaw peninsula have sandstone to either side. The underlying sandstone, to the east and south, is generally held to be non-conformable with the traps of the Keweenawan group, and has been identified by Dr. L. L. Hubbard, late state geologist, as of the Potsdam series. Copper is occasionally found in the eastern sandstone, near the point of contact with the trap, where evidences of igneous influence are quite plainly discernible; and in Ontonagon county fine copper has been found in the overlying sandstone conglomerate in the Porcupine mountains. The western sandstone is superimposed upon the Keweenawan beds and is apparently in place.

The outcrop of the trap rock formation, between the two sandstones, is from two to six miles wide, roughly speaking. The outcrop is narrowest where the dip of the strata is greatest, and widest where the strata dip least sharply. Toward the middle of the Keweenw Peninsula the western sandstone is lost under the water, and at Bete Gris Bay, the eastern sandstone also plunges beneath Lake Superior, leaving the traps and conglomerates in sole possession of the tip of the peninsula for the last ten miles, the waters covering the entire formation at the end of Keweenaw Point.

The Keweenawan series consists of three elementarily distinct classes of rock, though the subdivisions are numerous. These three principal groups are the traps, amygdaloids and conglomerates. The

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two former are old lava flows. The conglomerates are composed of broken rock, sand and gravel, cemented by pressure, and were once seabeds. The traps and amygdaloids are in many respects similar, the main difference being in the greater density and uniformity of the traps. The copper is found in a chemically pure, or native state, in the amygdoloids and conglomerates, and occasionally, to a limited extent, in the traps. The theory almost universally held is that the copper was deposited by precipitation in the cavities in the strata from the waters of a sea above. The traps being dense rocks, usually basic, there was little chance for the deposition of copper therein. The amygdaloids contained an infinite variety of granular and crystalline rock forms, the calcareous and silicious portions of which were dissolved quite readily by the waters, presumably powerfully impregnated with salts and minerals, and in the apertures left by the dissolution of the chalky and sandy nodules, the copper was deposited when precipitated from the waters above. There is also a theory that the copper is purely of igneous origin, but the preceding statement, in the main, gives the opinions of the majority of geologists, in lay language.

A cross-section of the trap formation at any given point would show a large number of strata of trap, amygdaloid and conglomerate rocks, lying one upon the other. These vary greatly in thickness, but are persistent, both as to length and depth. There must necessarily be an end to even the greatest lava-flow, and owing to inequalities existing on the land-surface or sea-bed over which these old lava-flows spread, the strata as now found, may be temporarily cut out, to reappear at greater depth, or to one side of the point of disappearance.

Geological observation in the copper district has been founded very largely on the conglomerates as base-lines, and many conglomerate reefs have been identified and traced for considerable distances. This system of geological identification is obviously founded on correct principles, as the conglomerates differ more radically from the traps and amygdaloids than do either of the latter from each other. All of the various strata of traps, amygdaloids and conglomerates vary from each other to a greater or less extent, according to their chemical and petrographical formation, crystallization, and the alterative influences to which they were subjected after their original deposition. Some of the traps are blue, others greenish in color, with various minerals added to the original diabase, such as augite, prehnite, calcite, and others. In addition to the diabase, there are felsite and porphyrytic rocks, richer in silica. The petrography of the district is, however, a topic on which a separate volume might be written, and which would call for more exact and extended knowledge than is possessed by the present writer.

Of the conglomerates, many carry copper in minute quantities, but only two have been mined upon, these being the Calumet and Allouez conglomerate reefs. The former is now being mined on by the Calumet & Hecla, the Tamarack, and the Tamarack Junior mine of

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the Osceola Consolidated Company. The Allouez conglomerate has been worked on by the Allouez and Peninsula mines. The Allouez company is not now working on the lode bearing its name, but the Franklin company is reopening the conglomerate at the Franklin Junior, formerly the Peninsula mine.

Nearly all the amygdaloids carry copper to some extent, but not all of them in sufficient quantity to render mining profitable. With the exception of the mines just noted as working on the conglomerates, all the active mines of the district, including producers and properties in process of development, are working on amygdaloid lodes, none of which approach the Calumet conglomerate in the amount of copper carried.

In addition to the main portion of the Keweenawan series, which is mainly composed of eruptive rocks, a second division, principally of sedimentary rocks, was formed at a later period, and in this second division the Nonesuch mine, in the Porcupine mountains, was opened and found very rich in fine copper. The second division of the Keweenawan series was formed mainly by the breaking down of the eruptive rocks of the preceding formation, and the redeposition of the rock so secured in the form of conglomerates and sandstones.

The crystalline rocks, owing to their greater cohesiveness, stand higher than the adjacent strata that had less power of resisting the elements and glacial action. These latter have been much eroded in ages past, in consequence of which the copper-bearing belt forms a ridge rising from 400 to 800 feet above the level of Lake Superior, with the sandstone sloping to the water from either side. In many places, especially at the crests and escarpments of the igneous strata, the naked rock stands out strongly, but the lower portions are covered with drift. In places an overburden of 200 or more feet of sand is found surmounting the rock, and swamps above the ledge of solid rock are of frequent occurrence. These are serious obstacles to the locating of mineral deposits, and also to the geological exploration of the district.

The dip of the various strata, copper-bearing and otherwise, varies greatly at different points, ranging from 78 degrees with the horizon at the Baltic, to as flat as 25 degrees at the Arnold. In a general way the dip of the trap series is sharpest when the trap belt, as exposed at surface, is narrowest; and flattest where the trap formation is widest. In a general way it may also be said, that the dip of the strata is sharpest nearest the eastern sandstone and flattest nearest the western sandstone, a palpable evidence of a folding or a pushing force exerted from the direction of the eastern or Potsdam sandstone. This evidence is further supplemented by the eastern sandstone being much tilted from the apparently horizontal position occupied a little further east, at the point of contact with the traps, the sandstone standing almost vertically at some places where adjoining the eruptive rocks.

In addition to the copper-bearing amygdaloids and conglomerates, there are three other sources of copper supply in the district, all of

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minor value, but of considerable geological interest. The first of these in importance, judging from the amount of copper produced in the past, is found in the fissure veins. These cross the formation at approximately right angles, and as a rule are nearly vertical in dip. They are probably cracks, coming long after the rocks composing the earth's crust were laid down by sedimentary and igneous action. The copper in these was presumably deposited from above in the same manner as the crevices in the amygdaloids and traps were filled with the same metal by precipitation from the sea. Some geologists adhere to the opinion that fissure veins were filled by eruptive matter from below. This idea is interesting, but unfortunately lacks evidence in its support, and was probably devised by some able theorist who was at a loss to account for the phenomena of fissures. The second source of copper is in the contact veins, of which the old Minnesota mine afforded much the best example, and further reference to which will be found in the article on the mine of the Michigan Copper Company. The third source of copper supply is found in the ores. These form an important feature of the geological and commercial aspect of the copper district, and have not received the attention in the past that their possibilities warrant. The Cliff, the first and one of the greatest dividend-payers among Michigan copper mines, was opened originally as a mine of black oxide of copper, which was found to some extent. The Calumet & Hecla was noted, when first opened in 1866, for the large amount of green carbonate of copper found in the conglomerate near surface, but in this instance the carbonate had been formed by the action of the elements from the native copper, which replaced it at a little depth. Various fissure veins of copper ore have been found, especially on Keweenaw Point, well toward the eastern end. The Mendota mine has a promising fissure vein, carrying a sulphide of copper which is unusually free from antimony and arsenic, two elements usually found in very close connection with copper, and more especially with sulphides and sulphurets. Antimony and arsenic are both refractory elements, retarding the process of smelting. The Clark mine carries a fissure vein of protoxide of manganese. The fissure veins of copper ore at the eastern end of the Keweenaw peninsula will probably receive the attention warranted by their promise at some time in the future, though at present no steps looking to that end are being taken.

On the old Shelden & Columbian property, in Houghton, a fissure vein of arsenide of copper was uncovered in 1899, while cutting a new street in that village. This mineral, which is at first of silvery gray lustre and irregular fracture, eventually turning to a greenish cast after exposure to the atmosphere, is named whitneyite. A later and more important discovery, of a somewhat similar sort, was made in February, 1900, at the Mohawk mine, when a fissure vein of the double arsenide of copper and nickel was discovered, more extended reference to which will be found in the paragraphs devoted to the Mohawk.

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Geographically, the Michigan copper district is contained in the three counties of Keweenaw, Houghton and Ontonagon, running from the point of the Keweenaw peninsula in the order named, in a southwesterly direction. Copper is also known to exist in considerable quantities on Isle Royale, which practically forms a portion of Keweenaw county, to which it is attached for judicial purposes. The Isle Royale formation dips to the southeast, and is in the northern fold of the great synclinal of the copper-bearing rock series. Much money has been expended there in mining, and some copper produced. but none secured at less than several times its cost. An isolated outrider of the copper formation is also found in Baraga county, rising from the surrounding sandstone, at Silver Mountain. The westerly continuation of the copper formation traverses Gogebic county, the trap hills being seen just north of the iron measures at Ironwood and Bessemer. Copper ore has also been found in Marquette county, but is entirely independent of the Keweenawan group, having been discovered in gash veins in the granite lying north of the iron measures. It is entirely probable that a considerable number of similar veins could be found by exploration in the Huron Mountain district, but they cannot be considered of great promise at present, all being narrow, with every indication that they would reach but shallow depths before pinching out.

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Statistical

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Lake Superior Copper Production.

LAKE SUPERIOR COPPER PRODUCTION, 1896 TO 1899, BY MINES.

Despite the popular impression that the production of copper by Lake Superior mines is increasing at the rate of about 10 per cent per annum, the actual production of refined copper for the year 1899 was 1,015,400 pounds less than for 1898, the decrease being 68-100 of 1 per cent. The following table gives the actual production of refined copper, by Michigan mines, for 1899 and the three preceding years, in pounds. With the exception of the 1899 production of the Arcadian, which is estimated, and the small credits given for 1898 and 1899 under the heading "Miscellaneous," the figures are from the official reports of the companies named, and may be relied on implicitly:

Mine.	1899.	1898.	1897.	1896.
Calumet & Hecla	89,610,963	86,426,320	83,248,054	89,280,621
Tamarack	18,565,602	19,660,480	20,222,529	16,044,860
Quincy	14,301,182	16,354,061	16,924,618	16,863,477
Osceola	11,358,049	12,682,297	11,201,103	9,526,415
Atlantic	4,675,882	4,397,339	5,109,663	4,832,497
Wolverine	4,500,373	4,588,114	2,316,296	2,196,791
Franklin	1,230,000	2,623,702	2,908,384	2,746,076
Arnold	763,911	152,320	.....	.....
Centennial	730,240	672,000	.....	.....
Baltic	621,336	42,766	.....	.....
Arcadian	500,000	.....	.....	.....
Mass	42,800	.....	65,250	53,507
Central	.....	291,339	614,891	469,243
Miscellaneous	50,000	75,000	91,798	64,013
Totals	146,950,338	147,965,738	142,702,586	142,057,500

LAKE SUPERIOR COPPER PRODUCTION FOR ALL YEARS, 1845 to 1899.

The following table gives the production of refined copper, by pounds, of the Lake Superior district, from the opening of the mines to the end of the year 1899. The figures for several of the years between 1883 and 1894 cannot be accepted as final, but I hope to have the

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exact statistics for the next volume of this work. The figures so questioned are fair approximations, however:

Year.	Lbs. Refined Copper.	Year.	Lbs. Refined Copper.
1845–1854	14,005,727	1877	39,026,671
1855	5,809,334	1878	41,687,266
1856	8,217,392	1879	42,671,529
1857	9,530,830	1880	49,718,337
1858	9,159,916	1881	54,548,909
1859	8,937,995	1882	57,155,980
1860	12,068,375	1883	59,702,404
1861	15,182,837	1884	69,353,202
1862	13,586,318	1885	72,147,889
1863	12,985,444	1886	80,918,460
1864	12,491,965	1887	76,028,697
1865	14,358,592	1888	86,472,034
1866	13,750,063	1889	88,175,675
1867	17,515,607	1890	101,410,277
1868	20,934,124	1891	114,222,709
1869	26,625,301	1892	123,198,460
1870	24,622,759	1893	112,605,078
1871	25,746,448	1894	114,308,870
1872	24,553,523	1895	129,330,749
1873	30,291,505	1896	142,057,500
1874	34,334,389	1897	142,702,586
1875	36,039,497	1898	147,965,738
1876	38,270,997	1899	146,950,338
		Total.	2,521,378,296

Percentage of Annual Increase of Michigan Copper Production.

Taking the production of the Lake Superior mines by five-year intervals, the products of those years and the percentage of gain from the fifth preceding year have been as follows:

Year.	Product—Lbs.	Per cent of gain.
1855	5,809,334	...
1860	12,068,375	108
1865	14,358,592	19
1870	24,622,759	71
1875	36,039,497	46
1880	49,718,337	38
1885	72,147,889	45
1890	101,410,277	40
1895	129,330,749	28

This gives an average increase of 49 per cent in each five-year period from 1855 to 1895, a term of forty years. The increase of the five-year period from 1855 to 1860 may be considered as abnormal, as it

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was in that time that the industry was becoming fairly fixed. Leaving out the increase of 108 per cent for the lustrum of 1855-60, the various periods from 1860 to 1895 show average gains of 41 per cent; from 1870 to 1895 the increase averages 39 per cent; and from 1880 to 1895 the gain averages 38 per cent for each five-year period. These computations indicate that the normal increase of production from the first firm establishment of the industry, forty years ago, has averaged about 40 per cent in each five-year period, which is almost exactly equivalent to an annual increase of 7 per cent. The impression that the ratio of increase in Lake copper production is about 10 per cent per annum has gained general credence and has even crept into estimates and statistics. The analysis given in the foregoing tables proves the fallacy of the theory. The difference between 7 per cent and 10 per cent may not appear large, but the use of the larger for the smaller ratio means that the annual increase of production by Lake Superior copper mines is usually overestimated by very nearly 50 per cent.

The production of the year 1900 is as likely to fall short of 150,000,000 pounds as it is to exceed that figure. Estimating the output at 150,000,000 pounds, which will be not far from the actual figures, the five-year period from 1895 to 1900 will show an increase of less than 16 per cent, the smallest noted since 1865. Had the average rate of increase of the preceding 35 years been maintained between 1895 and 1900, the output of the last named year would reach 181,063,048 pounds, instead of which it will fall about 30,000,000 pounds short of these figures. Prophecies of future production are necessarily unsafe guides, but taking into consideration all the present circumstances, it seems likely that the output of refined copper by Lake Superior mines will reach about 200,000,000 pounds in 1905, showing a gain of 30 to 35 per cent for the five-year period from 1900. These figures are necessarily subject to modifications brought about by future conditions, but may be accepted as a fair estimate from present data.

In this connection, it may be remarked, parenthetically, that the copper mining industry of Michigan has now reached a magnitude where the opening of new mines can have but little effect on production for five to ten years after their first work is done. The great mines of the district are growing steadily, and it is safe to state that no mine of the first class can possibly be opened and developed in less than ten years—although fine properties may be made in less time, as is evidenced by the Baltic, which is actually earning profits within three years after first being opened. It will take the Baltic at least ten more years, however, to open as large a mine as is warranted by the great width of its lode and extent of its surface.

Figuring percentages of increase from 1889 to 1894, and from 1894 to 1899, a gain of nearly 30 per cent was made in the first period, and of 28 per cent in the last five years.

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Percentage of Lake Superior Copper Production to Entire Output of the United States.

The following table shows the production of the entire United States and of the Lake Superior mines, by years, with the percentage of the total production of the country secured from Michigan mines, all figures being given in long tons, of 2,240 pounds each:

Year.	Total Product.	Lake Product.	Lake Percentage of Total.
1855	3,000	2,593	86
1856	4,000	3,666	91
1857	4,800	4,255	88
1858	5,500	4,088	74
1859	6,300	3,985	63
1860	7,200	5,388	74
1861	7,500	6,713	89
1862	9,000	6,065	67
1863	8,500	5,797	68
1864	8,000	5,576	69
1865	8,500	6,410	75
1866	8,900	6,138	69
1867	10,000	7,824	78
1868	11,600	9,346	80
1869	12,500	11,886	95
1870	12,600	10,992	87
1871	13,000	11,942	91
1872	12,500	10,961	87
1873	15,500	13,433	86
1874	17,500	15,327	87
1875	18,000	16,089	89
1876	19,000	17,085	89
1877	21,000	17,422	83
1878	21,500	17,719	82
1879	23,000	19,129	83
1880	27,000	22,204	82
1881	32,000	24,363	76
1882	40,467	25,439	62
1883	51,574	26,653	51
1884	64,708	30,961	47
1885	74,052	32,209	43
1886	70,430	36,124	51
1887	81,017	33,941	42
1888	101,054	38,604	38
1889	101,239	39,364	38
1890	115,966	45,273	39
1891	126,839	50,992	40
1892	154,018	54,999	36
1893	147,033	50,270	34
1894	158,120	51,031	32
1895	169,917	57,737	34
1896	205,384	64,073	31
1897	220,571	64,854	29
1898	235,050	65,602	28

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Calumet & Hecla's Proportion of Total Lake Superior Copper Production.

The Calumet & Hecla is a giant among mines, and even in the great copper district of Lake Superior, where the second-class mines are larger than the greatest properties of most mineral fields, it dwarfs its competitors. The following table gives the total production of Michigan mines and also the production of the Calumet & Hecla, by years, showing the proportion of the total output secured from that single mine, which is now producing at the rate of almost exactly 10 per cent of the entire copper production of the world:

Year.	Total Lake Product.	C. & H. Product.	C. & H. Percentage of Whole.
1845-1866	150,084,788	.....	..
1867	17,515,607	1,315.173	7
1868	20,934,124	5,098,375	24
1869	26,625,301	12,315,771	46
1870	24,622,759	14,031,584	57
1871	25,746,448	16,222,590	63
1872	24,553,523	16,162,183	66
1873	30,291,505	18,848,265	62
1874	34,334,389	20,125,225	57
1875	36,039,497	21,473,954	59
1876	38,270,997	21,690,732	56
1877	39,026,671	23,568,468	60
1878	41,687,266	25,253,128	60
1879	42,671,529	26,270,943	61
1880	49.718,337	31,675,239	63
1881	54,548,909	31,360,781	57
1882	57,155,980	32,053,528	56
1883	59,702,404	33,125,045	55
1884	69,353,202	40,473,585	58
1885	72,147,889	47,247,990	65
1886	80,918,460	50,518.220	62
1887	76,028,697	46,016,123	60
1888	86,472,034	50,295,721	58
1889	88,175,675	48,668,296	55
1890	101,410,277	59.868,106	59
1891	114,222,709	63,586,620	55
1892	123,198,460	56,495,211	46
1893	112,605,078	60,427,913	53
1894	114,308,870	61.324,626	53
1895	129,330,749	79,137,399	61
1896	142,057,500	89,280,621	62
1897	142,702,586	83,248.054	58
1898	147,965,738	86,426,320	55
1899	146,950,338	89,610,963	61
Total	2,521,378,296	1,363,216,752	54

The foregoing table shows that 54 per cent of the total Lake Superior copper production has come from this one mine, which has the record of having produced the largest amount of copper of any mine in the new world, though its production has perhaps been excelled by the

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Rio Tinto of Spain, which has been worked for centuries. The Calumet & Hecla is in many respects an exception among mines. It sprang, full panoplied, like Minerva from the head of Jove, to a commanding position among the wondrous treasure vaults of man. Although its first copper was made in 1867, the year following its opening, the Calumet & Hecla produced 46 per cent of the Lake Superior total two years later, and from 1870 until 1899 it has made from 46 to 66 per cent of the total annual output of the Michigan copper mines. Its ratio of growth in production has been about the same as that of the district as a whole, showing that the other mines have not been impeded in their own development by the growth of their greater neighbor.

Value of Lake Copper Production.

TOTAL ANNUAL VALUES OF LAKE SUPERIOR COPPER PRODUCTION 1845 to 1899.

The following table gives the estimated value of the copper production of Lake Superior mines, from the first product in 1845 until the close of 1899. Sub-totals for five and ten year periods are also appended:

Year.	Value.	Five-yr. totals.	Ten-yr. totals.
1845–54	$ 3,146,400	$ 3,146,400	
1855	1,586,160		
1856	2,218,320		
1857	2,382,500		
1858	2,129,235		
1859	1,950,355	10,266,570	$13,412,970
1860	2,654,960		
1861	3,487,995		
1862	3,634,255		
1863	4,415,600		
1864	5,870,300	20,063,110	
1865	5,635,515		
1866	4,629,375		
1867	4,442,841		
1868	4,940,424		
1869	6,230,016	25,878,171	45,941,281
1870	5,096,752		
1871	5,728,485		
1872	7,979,400		
1873	8,726,100		
1874	8,009,356	35,540,093	
1875	8,180,626		
1876	7,998,430		
1877	7,327,888		
1878	6,920,540		
1879	7,327,350	37,754,834	73,294,927

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Year.	Value.	Five-yr. totals.	Ten-yr. totals.
1880.....	9,947,673		
1881.....	9,971,702		
1882.....	10,522,416		
1883.....	9,457,853		
1884.....	9,494,306	49,393,950	
1885.....	7,942,597		
1886.....	8,788,476		
1887.....	8,530,342		
1888.....	14,510,001		
1889.....	11,894,942	51,666,358	101,060,308
1890.....	15,819,960		
1891.....	14,574,727		
1892.....	12,431,624		
1893.....	12,105,145		
1894.....	10,852,122	65,783,578	
1895.....	13,877,109		
1896.....	15,758,935		
1897.....	16,530,843		
1898.....	17,829,871		
1899.....	26,098,382	90,095,140	155,878,718
Totals..	389,588,204	389,588,204	389,588,204

INCREASE IN VALUE OF MICHIGAN COPPER PRODUCTION BY DECADES 1859 TO 1899.

The following table illustrates the steady and rapid growth of the value of copper production by Michigan mines, by decades, from the establishment of the industry in 1845. Detailed figures of production of the first ten years not being at hand, the period of 15 years, from 1845 to 1859, is given in lieu of the first decade:

Decade.	Value Product.	Per Cent Increase.
Ending 1859.....	$ 13,412,970.....	...
" 1869.....	45,941,281.....	243
" 1879.....	73,294,927.....	59
" 1889.....	101,060,308.....	38
" 1899.....	155,878,718.....	54

The average decennial increase for the past thirty years has been a trifle more than 50 per cent.

Prices Lake Ingot Copper.

MONTHLY PRICES OF AMERICAN COPPER, 1860–1899.

The following tables give the highest and lowest prices per pound, in cents, for Lake Superior copper in the New York market, for every month in the years 1860 to 1899, inclusive:

(See pages 42–43 following.)

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Year.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1860.....	24	23½	24	23⅝	23⅝	23	23½	23	23¼	22⅝	22½	21⅝
1861.....	20	19	19½	19	19⅝	19¼	19⅝	19	19⅝	19¼	19	18
1862.....	28	27	28	25	25	23	23	21½	21½	20⅝	23	20⅝
1863.....	35	31	37	35	37	31	31	30	30½	30	30½	30
1864.....	41½	39	42	41½	42½	41½	44	42½	44	43	49	44
1865.....	50½	46	46	44	44½	34	35	34	34	30	30½	28½
1866.....	42	38	38	35½	35½	29½	30	28½	31	29	33	31
1867.....	29½	27	27⅝	27½	27½	24	24½	23½	24¼	24	24½	24
1868.....	23½	21¼	24	22½	24	23¼	24¼	23¼	24¼	24	24	23½
1869.....	26¼	23⅝	27	26	26⅝	24	24	23¼	24¼	23⅝	23⅝	22
1870.....	22	21⅛	21¼	20⅞	20⅝	19	19⅝	19¼	19½	19	20⅛	19
1871.....	22⅛	22	22⅛	21⅞	22	21½	21⅝	21¼	21⅝	21⅛	21½	21¼
1872.....	28½	27⅛	28⅛	28¼	30½	28⅛	44	30½	42	36	34⅝	33
1873.....	35	32½	35	34	35	34½	34½	30½	33½	32	31½	29⅛
1874.....	25	24½	25	24⅛	24⅝	24	25	24⅝	25	24½	24⅝	24¼
1875.....	23½	21½	22⅝	21⅝	21⅝	21½	21⅝	21½	23¼	22⅝	23	23
1876.....	23¼	23	22⅞	22½	22¼	22	22⅛	22	22⅛	21	21	19½
1877.....	19½	19	20½	19½	19½	19	19½	19¼	19¼	19	19⅜	19
1878.....	17⅛	17¼	17½	17⅛	17⅛	16⅞	17	16⅞	16⅝	16¼	16⅜	16¼
1879.....	16	15½	15½	15½	15⅝	15⅝	16	15⅝	16¼	16	16¼	16⅛
1880.....	25	21⅜	24½	24	24	22⅝	22½	24	21	18	18½	17⅞
1881.....	19⅜	19⅜	19⅜	19⅛	19⅜	19	19	18⅝	18⅞	18¼	18¼	16⅜
1882.....	20⅜	20¼	20	19	19¼	18⅞	18⅞	17⅞	18¼	18	18¼	18
1883.....	18⅛	18	17⅞	17⅝	17⅜	17⅛	16	15⅝	16	15⅞	15⅞	15
1884.....	15	14⅞	15	14⅞	15	14⅝	15	14½	14½	14⅛	14½	14
1885.....	11½	10⅜	11⅞	10 4/5	11⅛	10 2/5	11¼	10 1/10	11½	9 4/5	11½	11
1886.....	11⅜	11⅜	11⅜	11⅜	11½	11⅜	11½	11⅜	11⅛	10	10⅛	10
1887.....	12	11⅛	11⅛	10 1/5	10½	10⅜	10 1/5	10	10	9 19/20	10¼	10
1888.....	17 4/10	15 17/20	16 6/10	16	16 7/20	15 19/20	16 9/10	16	16¼	16 3/10	16⅛	16 9/20
1889.....	17½	16½	16¼	16½	15¼	15	16	15½	12⅛	12	12 13/40	12
1890.....	14⅓	14¼	14¼	14¼	14¼	14	14⅓	14¼	15¼	14⅝	16¼	15¼
1891.....	15	14⅝	14⅝	14¼	14¼	13⅝	13¾	13½	13¾	12¾	13	12⅞
1892.....	11	10¾	10¾	10½	12	10¾	12	11¾	12¼	12	11⅞	11½
1893.....	12½	12¼	12¼	12	12	11¾	11½	11¼	11⅛	11	11	10¾
1894.....	10¼	10	10	9⅝	9⅝	9⅝	9½	9⅜	9⅝	9¼	9⅛	9
1895.....	10	9⅞	9⅞	9½	9½	9¼	9¾	9⅝	10⅝	9¾	10¾	10½
1896.....	10⅛	9¾	11¼	10	11¼	10⅞	11	10¾	11½	10⅞	11¾	11½
1897.....	12	11½	12	11⅞	11⅞	11½	11½	11	11⅛	10¾	11⅛	10⅞
1898.....	11	10 9/10	11¾	11	12	11⅜	12⅛	11⅞	12⅛	12	11⅞	11¾
1899.....	13¼	17	17	18½	17¼	18	18	19⅜	18½	19¼	17⅞	18¼

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Year.	July.		August.		September		October.		November		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1860.....	21¾	21½	21½	21½	22	21½	22	21½	21½	20¼	20¼	19¾
1861.....	18	17½	19	17¾	20¼	19	20¼	20	22½	20¼	27	22½
1862.....	24½	22½	24½	24	27	24¼	32⅜	27	32⅞	30½	31½	30½
1863.....	32	29	31	29	32¼	31	34¼	32¼	38½	34½	38¾	38½
1864.....	55	49	52½	50	52½	47½	48	47	49	47	50	48½
1865.....	30¼	28	32	30½	32¾	31½	33	32½	45½	33	45½	39¼
1866.....	33⅓	31	31	30	31½	30¾	31	30¾	30¾	26½	29	26½
1867.....	26	24	26¼	25¾	27¼	26¼	26¾	22¾	23	22¾	23	21½
1868.....	24½	23⅛	24¼	24	24	23¾	24	23	24	22½	24½	23¾
1869.....	22¼	21⅞	23⅛	21⅞	23	22	22¾	22	22½	22	22	21½
1870.....	20½	20⅜	21⅜	20⅛	21½	20¾	21¾	21½	23⅜	21¾	22⅝	22¼
1871.....	22¼	21⅜	23	22⅜	23⅞	22⅞	23⅞	23¼	24¼	23¼	27	24½
1872.....	34	33	35	32½	35¼	33	34¾	31¼	32¼	30¾	32½	30½
1873.....	29	26⅝	27½	27	27	25½	25½	24	24	21	25	23
1874.....	24¼	20	21	19	21¼	21	22½	21¼	23¾	22¼	23¼	23½
1875	23	22⅝	23⅜	23	23⅞	23½	23¼	23	23¼	23	23⅝	23⅝
1876.....	20	19½	19½	18¾	21	18¾	21¼	20½	20½	20	20	19⅝
1877.....	19¼	19	19	17⅞	18½	17⅞	18	17¾	17¾	17⅝	17¾	17½
1878.....	16¼	16	16	16	16¼	16	16	15½	15⅞	15½	16	15⅞
1879.....	16⅛	16	16⅜	16	17	16¼	21½	18	21¾	21	21½	21
1880.....	18⅝	18½	19⅛	19	18⅞	18¾	18⅞	18¾	18⅞	18¾	19⅛	18⅝
1881.....	16½	16	16⅜	16⅜	18⅛	16¾	18⅜	18	19	18⅛	20⅜	19¼
1882.....	18¼	18⅛	18¼	18⅛	18¼	18	18¼	18	18⅛	18	18	17⅞
1883... ..	15⅛	15	15	15	15½	15⅛	15½	15⅛	15	14⅞	15	14⅞
1884.....	14⅛	13⅞	14	13⅞	13⅛	13	13⅛	12⅞	13	12½	12⅛	11
1885.....	11¼	10⅞	11¼	11	11⅛	10 19/20	11⅛	10⅘	11⅛	10⅘	11½	11 1/10
1886.....	10⅛	10	10¼	10	11⅛	10¼	11⅛	11⅛	12	11⅛	12⅛	11⅛
1887.. ...	10⅛	10⅛	10⅛	10⅗	11	10⅝	12 3/20	10 3/10	14 19/20	11 11/20	17⅛	14 19/20
1888.....	16 9/10	16 13/20	17	16⅖	17 7/10	16 9/10	17⅗	17 7/20	17⅗	17½	17 9/20	17 1/10
1889.....	12	12	12	12	12	11	11	11	13¼	11¼	14¼	14
1890.....	17¼	16½	17¼	17	17	17	16⅞	16⅛	16⅛	16⅛	16	15
1891.....	12⅞	12½	12⅜	12	12½	12⅛	12⅜	11⅜	11½	11	11⅛	10¼
1892.....	11⅛	11¼	11⅛	11 6/10	11 6/10	11 1/10	11⅛	11 1/10	12	11⅛	12⅜	12¼
1893.....	10½	10¼	10⅛	9⅗	9⅞	9⅛	9⅛	9⅛	10¼	9⅛	10½	10⅜
1894.....	9⅛	9	9⅛	9	9⅞	9⅛	9⅛	9½	9½	9⅜	10	9½
1895.....	11⅛	10½	12¼	11⅛	12¼	12	12	11⅛	11⅜	11	11	10
1896.....	11⅛	11	11⅓	10⅞	10⅞	10⅜	10⅞	10½	11½	10⅞	11½	11½
1897.....	11⅓	11	11¼	11	11⅜	11¼	11¼	11	11	10⅛	11	10⅞
1898.....	11⅜	11½	12⅓	11⅜	12¼	12⅓	11½	12¼	11⅛	12½	12⅞	12⅜
1899	18¼	18½	18½	18¼	18⅜	18½	17	18½	17	17¼	16¼	17

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HIGHEST AND LOWEST PRICES OF LAKE SUPERIOR COPPER, 1860 TO 1899.

Year.	Lowest Price.		Highest Price.		
1860	19¾	c. in	December 24	c. in	January.
1861	17½	"	July 27	"	December.
1862	20¾	"	May 32⅞	"	November.
1863	29	"	July 38¾	"	December.
1864	39	"	January 55	"	July.
1865	28	"	July 50½	"	January.
1866	26½	"	November 42	"	January.
1867	21½	"	December 29¼	"	January.
1868	21½	"	January 24½	"	December.
1869	21½	"	December 27	"	February.
1870	19	"	March 23⅜	"	November.
1871	21¼	"	April 27	"	December.
1872	27⅛	"	January 44	"	April.
1873	21	"	November 35	"	January.
1874	19	"	August 25	"	January.
1875	21½	"	January 23⅞	"	September.
1876	18¾	"	August 23¼	"	January.
1877	17½	"	December 20½	"	February.
1878	15½	"	October 17⅜	"	January.
1879	15½	"	January 21¾	"	November.
1880	17⅞	"	June 25	"	January.
1881	16	"	July 20⅜	"	December.
1882	17⅞	"	April 20⅜	"	January.
1883	14⅞	"	November 18⅛	"	January.
1884	11	"	December 15	"	January.
1885	9⅜₀	"	May 11⅞	"	February.
1886	10	"	May 12⅛	"	December.
1887	9.95	"	May 17¾	"	December.
1888	15.85	"	January 17.60	"	November.
1889	11	"	September 17½	"	January.
1890	14	"	March 17¼	"	July.
1891	10¼	"	December 15	"	January.
1892	10½	"	February 12⅜	"	December.
1893	9.60	"	August 12½	"	January.
1894	9	"	June 10¼	"	January.
1895	9⅜	"	April 12¼	"	August.
1896	9¾	"	January 12	"	June.
1897	10¾	"	November 12	"	January.
1898	11	"	January 13¼	"	December.
1899	13¼	"	January 19⅜	"	April.

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Dividends.

DATES AND NUMBER OF DIVIDENDS PAID BY LAKE SUPERIOR COPPER MINES.

The following table gives dates of the earliest and latest payment of dividends of every Lake Superior copper mine that has ever returned a profit, also total number of dividends paid to and including the year 1899:

Mine.	Date first dividend.	Date last dividend.	Total No. dividends paid.
Cliff	1849	1867	37
Minnesota	1854	1876	19
National	1861	1872	9
Pewabic	1862	1873	11
Quincy	1862	1899	67
Franklin	1863	1894	21
Central	1864	1891	30
Copper Falls	1864	1871	3
Hecla	1869	1871	7
Calumet	1870	1871	3
Calumet & Hecla	1871	1899	109
Ridge	1873	1880	4
Phœnix	1877	1877	1
Atlantic	1878	1898	16
Osceola	1878	1899	48
Tamarack	1888	1899	33
Kearsarge	1890	1897	3
Wolverine	1898	1899	3

The Cliff mine has long been idle and the affairs of its original owners wound up. The Minnesota company went out of business nearly a quarter of a century since, and the property is now owned by the Michigan Copper Company. The National has been idle for some years, though it should have resumed work in the present era of good times for good copper mines. The Pewabic company was forced out of existence and the mine is now a portion of the Quincy. The Franklin has paid no dividends since 1894, owing to the cost of purchasing and developing new mining property and building a new stampmill. The Central is idle and apparently worked out, so far as the fissure vein on which the mine was opened is concerned. Copper Falls is now a portion of the Arnold mine. The Hecla and Calumet were consolidated under the name of the Calumet & Hecla in May, 1871. The Ridge is now a part of the Mass Consolidated. The Phœnix has been reorganized and is in new and capable hands. Kearsarge was absorbed by the Osceola Consolidated Company in 1897. The other mines named are still active dividend payers.

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Total Lake Superior Copper Dividends, by Mines, to End of 1899.

The dividends from Lake Superior copper mines have been paid by the following named companies:

Company.	Amount.
Atlantic	$ 780,000
Cliff	2,518,620
Central	1,970,000
Copper Falls	100,000
Calumet	300,000
Calumet & Hecla	64,900,000
Franklin	1,240,000
Hecla	650,000
Kearsarge	160,000
Minnesota	1,820,000
National	320,000
Osceola	3,094,500
Pewabic	1,000,000
Phoenix	20,000
Quincy	11,420,000
Ridge	100,000
Tamarack	6,270,000
Wolverine	270,000
Total	$96,933,120

Lake Superior Copper Mine Dividends in 1900.

The dividends of Lake Superior copper mines for all years to and including 1899 are given in the preceding table. To Oct. 1, 1900, the following dividends have been paid since the beginning of the year:

Mine.	Dividends.
Atlantic	$ 80,000
Calumet & Hecla	5,000,000
Osceola	279,000
Quincy	900,000
Tamarack	420,000
Wolverine	240,000
Total	$6,919,000

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Supplementary to which the following named additional disbursements may reasonably be anticipated before the close of the year:

Mine.	Dividends.
Calumet & Hecla	$2,000,000
Osceola	279,000
Tamarack	420,000
Total	$2,699,000

Making a probable total of $9,618,000 for the calendar year 1900. The Tamarack and Osceola dividends may prove larger than estimated, and unforeseen accidents may lessen any of the three estimated dividends, but it is probable that the estimated amounts will be paid.

Total Lake Superior Copper Mine Dividends to Oct. 1, 1900.

The disbursement of a dividend of $400,000 by the Quincy mine on Aug. 15, 1900, marked the completion of the payment to the shareholders of the first hundred million dollars of profits from Lake Superior copper mines. The total amount of dividends paid to and including Oct. 1, 1900, is $102,852,120. Adding the figures of 1900 dividends to Oct. 1 to the previous totals, the six mines credited with dividend payments this year have disbursed the following sums in profits to shareholders, in addition to which, the six properties named were worth, on Sept. 8th, 1900, the grand sum of $111,570,000:

Mine.	Total Dividends to Oct. 1, 1900.
Atlantic	$ 960,000
Calumet & Hecla	70,850,000
Osceola	3,373,500
Quincy	12,320,000
Tamarack	6,690,000
Wolverine	510,000

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LAKE SUPERIOR COPPER MINE DIVIDENDS BY YEARS, 1849 to 1899.

The total dividends of the Lake Superior copper mines, by years, with sub-totals for five and ten year periods, have been as follows:

Year.	Dividends.	Total 5-yr. Period.	Total 10-yr. Period.
1849.....	$ 60,000	$ 60,000	$ 60,000
1850.....	84,000		
1851.....	60,000		
1852.....	60,000		
1853.....	90,000		
1854.....	198,000	492,000	
1855.....	168,000		
1856.....	380,000		
1857.....	480,000		
1858.....	460,000		
1859.....	360,000	1,848,000	2,340,000
1860.....	120,000		
1861.....	260,000		
1862.....	440,000		
1863.....	720,000		
1864.....	1,150,000	2,690,000	
1865.....	510,000		
1866.....	170,000		
1867.....	110,000		
1868.....	100,000		
1869.....	210,000	1,100,000	3,790,000
1870.....	700,000		
1871.....	1,640,000		
1872.....	3,080,000		
1873.....	2,330,000		
1874.....	1,940,000	9,690,000	
1875.....	1,920,000		
1876.....	1,870,000		
1877.....	1,840,000		
1878.....	1,860,000		
1879.....	1,818,620	9,308,620	18,998,620
1880.....	3,080,000		
1881.....	2,665,000		
1882.....	2,850,000		
1883.....	2,670,000		
1884.....	1,327,500	12,592,500	
1885.....	1,970,000		
1886.....	1,900,000		
1887.....	1,370,000		
1888.....	3,260,000		
1889.....	2,670,000	11,170,000	23,762,500
1890.....	3,415,000		
1891.....	3,540,000		
1892.....	3,260,000		
1893.....	3,520,000		
1894.....	2,380,000	16,115,000	
1895.....	3,280,000		
1896.....	3,985,000		
1897.....	5,431,000		
1898.....	6,853,000		
1899.....	12,318,000	31,867,000	47,982,000
Totals....	$96,933,120	$96,933,120	$96,933,120

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The foregoing figures tell more eloquently than words of the financial history of the Lake copper country. They also testify that the present is a time of absolutely unparalleled prosperity in the district—testimony that is amply corroborated by the steadiest work, at the highest average wages, of the largest number of miners ever given employment in the district, and the payment of dividends that are unequalled in previous years, and having few parallels in the world.

The dividends of the past five years were much larger than the total dividends paid in the first 30 years of copper mining, and amounted to very nearly one-third of the total dividends paid in 51 years.

The dividends of the past ten years cover very nearly one-half the total dividend payments of 51 years. The dividends of the last two years are nearly 20 per cent of the total profits of over half a century, and the dividends of 1899 alone are more than one-eighth of the grand total of dividends paid by all the mines of the district since the first copper was mined. The dividends paid in 1899 were greater than the total paid from the first disbursement of profits in 1849 until the end of 1872—a period of very nearly a quarter of a century. The 1899 dividends were very nearly twice as large as the dividends of four years so comparatively recent as 1884–5–6–7. The Calumet & Hecla dividends alone, for the year 1899, were 17 per cent greater than the profit disbursements of all Lake Superior mines from the first payment in 1849 until and including the year 1871, in which latter year the Calumet & Hecla paid its first dividend, amounting to $900,000, although $950,000 had been paid shareholders by the Hecla and Calumet companies before their consolidation.

Detailed Dividends of all Lake Superior Copper Mines, by Years, 1849 to 1899.

Four years after the first copper was mined in Michigan, the first dividend was paid therefrom. From that year, now more than half a century gone, Lake copper mines have returned profits to the pockets of shareholders every twelvemonth. Some years have been more prosperous than others, but even in the leanest years thousands of dollars of profits have been disbursed. The appended table is the first ever published showing dividends for all years by Lake Superior mines:

Mine.	1849.	1850.	1851.	1852.
Cliff.....	$ 60,000	$ 84,000	$ 60,000	$ 60,000
Totals.....	60,000	84,000	60,000	60,000

	1853.	1854.	1855.	1856.
Cliff.....	$ 90,000	$ 108,000	$ 78,000	$ 180,000
Minnesota.....	.....	90,000	90,000	200,000
Totals.....	90,000	198,000	168,000	380,000

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	1857.	1858.	1859.	1860.
Cliff	$ 180,000	$ 160,000	$ 180,000	$ .....
Minnesota	300,000	300,000	180,000	120,000
Totals	480,000	460,000	360,000	120,000

	1861.	1862.	1863.	1864.
Cliff	$ 80,000	$ 80,000	$ 180,000	$ 320,000
Minnesota	100,000	160,000	160,000	60,000
National	80,000	80,000	.....	80,000
Pewabic	.....	60,000	120,000	200,000
Quincy	.....	60,000	200,000	280,000
Franklin	.....	.....	60,000	100,000
Central	.....	.....	.....	50,000
Copper Falls	.....	.....	.....	60,000
Totals	260,000	440,000	720,000	1,150,000

	1865.	1866.	1867.	1868.
Cliff	$ 200,000	$ 120,000	$ 60,000	$ .....
National	40,000	.....	.....	.....
Quincy	160,000	.....	.....	60,000
Franklin	60,000	.....	.....	.....
Central	50,000	50,000	50,000	40,000
Totals	510,000	170,000	110,000	100,000

	1869.	1870.	1871.	1872.
Cliff	$	$	$ 100,000	$ 100,000
Minnesota	.....	.....	.....	50,000
National	.....	.....	20,000	20,000
Pewabic	.....	.....	20,000	40,000
Quincy	40,000	120,000	140,000	350,000
Franklin	.....	.....	20,000	40,000
Central	70,000	80,000	50,000	80,000
Copper Falls	.....	.....	40,000	.....
Hecla	100,000	300,000	250,000	.....
Calumet	.....	200,000	100,000	.....
Calumet & Hecla	.....	.....	900,000	2,400,000
Totals	210,000	700,000	1,640,000	3,080,000

	1873.	1874.	1875.	1876.
Minnesota	$	$	$	$ 10,000
Pewabic	20,000	.....	.....	.....
Quincy	100,000	160,000	220,000	160,000
Central	160,000	160,000	80,000	100,000
Calumet & Hecla	2,000,000	1,600,000	1,600,000	1,600,000
Ridge	50,000	20,000	20,000	38,620
Totals	2,330,000	1,940,000	1,920,000	1,870,000

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	1877.	1878.	1879.	1880.
Cliff	$	$	$ 38,620	$ .....
Quincy	80,000	100,000	40,000	220,000
Central	140,000	100,000	80,000	100,000
Calumet & Hecla.	1,600,000	1,600,000	1,600,000	2,500,000
Ridge	.....	.....	.....	10,000
Phœnix	20,000	.....	.....	.....
Atlantic	.....	20,000	.....	40,000
Osceola	.....	40,000	60,000	210,000
Totals	1,840,000	1,860,000	1,818,620	3,080,000

	1881.	1882.	1883.	1884.
Quincy	$ 320,000	$ 520,000	$ 380,000	$ 280,000
Franklin	.....	.....	.....	80,000
Central	120,000	50,000	60,000	40,000
Calumet & Hecla.	2,000,000	2,000,000	2,000,000	800,000
Atlantic	.....	80,000	80,000	40,000
Osceola	225,000	200,000	150,000	87,500
Totals	2,665,000	2,850,000	2,670,000	1,327,500

	1885.	1886.	1887.	1888.
Quincy	$ 180,000	$ 240,000	$ 200,000	$ 360,000
Franklin	40,000	80,000	40,000	120,000
Central	30,000	40,000	40,000	70,000
Calumet & Hecla.	1,700,000	1,500,000	1,000,000	2,000,000
Atlantic	20,000	40,000	40,000	120,000
Osceola	.....	.....	50,000	150,000
Tamarack	.....	.....	.....	440,000
Totals	1,970,000	1,900,000	1,370,000	3,260,000

	1889.	1890.	1891.	1892.
Quincy	$ 280,000	$ 320,000	$ 450,000	$ 350,000
Franklin	80,000	80,000	80,000	160,000
Central	40,000	20,000	20,000	.....
Calumet & Hecla.	1,500,000	2,000,000	2,000,000	2,000,000
Atlantic	80,000	100,000	40,000	.....
Osceola	50,000	225,000	150,000	150,000
Tamarack	640,000	590,000	800,000	600,000
Kearsarge	.....	80,000	.....	.....
Totals	2,670,000	3,415,000	3,540,000	3,260,000

	1893.	1894.	1895.	1896.
Pewabic	$ 400,000	$	$ 140,000	$ .....
Quincy	300,000	400,000	600,000	1,000,000
Franklin	120,000	80,000	.....	.....
Calumet & Hecla	2,000,000	1,500,000	2,000,000	2,500,000
Osceola	100,000	.....	100,000	125,000
Tamarack	600,000	400,000	400,000	360,000
Kearsarge	.....	.....	40,000	.....
Totals	3,520,000	2,380,000	3,280,000	3,985,000

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	1897.	1898.	1899.
Quincy	$ 800,000	$1,000,000	$ 950,000
Calumet & Hecla	4,000,000	5,000,000	10,000,000
Atlantic	40,000	40,000	.....
Osceola	191,000	273.000	558,000
Tamarack	360,000	480,000	600,000
Kearsarge	40,000	.....	.....
Wolverine	.....	60,000	210,000
Totals	5,431,000	6,853,000	12,318,000

TOTAL LAKE SUPERIOR COPPER DIVIDENDS, BY MINES AS CONSTITUTED IN 1900.

In the course of time there are considerable changes in the holdings of properties, whence it follows that some mines have a variety of aliases. There have been portions of mines set aside from the parent stem; also consolidations. The early tendency was to lop off as many branches as possible from a promising property—that was the early idea idea of cutting the pie. Of late years the tendency has been in the opposite direction.

Some of the mines credited on the foregoing list with dividend payments are now portions of properties bearing entirely different names. Rearranging the table of dividend-payers, with reference to the present owners of the lands, the following named mines are to be credited with having earned the nearly one hundred millions of dollars distributed as profits by Lake Superior copper mining corporations to the end of 1899:

Name Present Owner	Dividends Paid from Lands
Arnold (Copper Falls)	$ 100,000
Atlantic	780,000
Cliff	2,518,620
Central	1,970,000
Calumet & Hecla (including Hecla and Calumet)	65,850,000
Franklin	1,240,000
Michigan (Minnesota)	1,820,000
Mass (Ridge)	100,000
National	320,000
Osceola (including Kearsarge)	3,254,500
Phœnix	20,000
Quincy (including Pewabic)	12,420,000
Tamarack	6,270,000
Wolverine	270,000
Total	$96,933,120

PERCENTAGE OF ANNUAL DIVIDENDS TO GROSS VALUE OF MICHIGAN COPPER PRODUCT, 1849 to 1899.

The following table gives in the first column the estimated value of the annual products of copper from 1849, the year of the payment of the first dividend by a Michigan copper mine; the second column gives the gross dividend returns for each year for 51 years, and the third column shows the percentage of the gross value of the product returned

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to shareholders in dividends. The fourth and fifth columns show the average percentage of dividend returns for five and ten-year periods:

Year.	Gross Value Copper Product.	Gross Dividend Returns.	Per Cent of Dividends.	Average Per Cent 5-year Periods.	Average Per Cent 10-year Periods.
	....	....		....	....
1849	$ 336,000	$ 60,000	17.		
1850	286,000	84,000	29.		
1851	289,500	60,000	12.		
1852	396,000	60,000	15.		
1853	648,500	90,000	14.		
1854	909,500	198,000	21.	22.	
1855	1,586,160	168,000	10.		
1856	2,218,320	380,000	17.		
1857	2,382,500	480,000	20.		
1858	2,129,235	460,000	21.		
1859	1,950,355	360,000	18.	17.	20.
1860	2,654,960	120,000	5.		
1861	3,487,995	260,000	7.		
1862	3,634,255	440,000	12.		
1863	4,415.600	720,000	16.		
1864	5,870,300	1,150,000	19.	12.	
1865	5,635,515	510,000	9.		
1866	4,629,375	170,000	3.7		
1867	4,442,841	110,000	2.4		
1868	4,940,442	100,000	2.		
1869	6,230,016	210,000	3.4	4.	8.
1870	5,096,752	700,000	13.		
1871	5,728,485	1,640,000	29.		
1872	7,979,400	3,080,000	38.		
1873	8,726,100	2,330,000	27.		
1874	8,009,356	1,940,000	24.	26.	
1875	8,180,626	1,920,000	23.		
1876	7,998,430	1,870,000	23.		
1877	7,327,888	1,840,000	25.		
1878	6,920,540	1,860,000	27.		
1879	7,327,350	1,818,620	25.	25.	25.
1880	9,947,673	3,080,000	31.		
1881	9,971,702	2,665,000	27.		
1882	10,522,416	2,850,000	27.		
1883	9,457,853	2,670,000	28.		
1884	9,494,306	1,327,500	14.	25.	
1885	7,942,597	1,970,000	25.		
1886	8,788,476	1,900,000	21.		
1887	8,530,342	1,370,000	16.		
1888	14,510,001	3,260,000	22.		
1889	11.894,942	2,670,000	22.	23.	24.
1890	15,819,960	3.415,000	21.6		
1891	14,574,727	3,540,000	24.3		
1892	12,431,624	3,260,000	26.2		
1893	12,105,145	3,520,000	29.1		
1894	10,852,122	2,380,000	21.9	24.6	
1895	13,877,109	3,280,000	23.6		
1896	15,758,935	3,985,000	25.3		
1897	16,530,843	5,431,000	32.8		
1898	17,829,871	6,853,000	38.4		
1899	26,098,382	12,318.000	47.2	33.5	29.
Totals	$389,367.304	$ 96,983,120	24.9		

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Almost exactly one-fourth of the market value of the copper product has been returned to shareholders in dividends. It is also to be noted that the average rate of 24.9 per cent for the entire fifty years is almost exactly the dividend rate averaged for the past thirty years. Estimating $50,000,000 as the amount originally invested in lands, machinery and operation, outside of the sums re-invested from earnings, and placing the present market value of the mines as $125,000,000, it is possible to strike a sort of balance sheet of the Lake Superior copper mining industry as a whole. The trial balance will show that the Michigan copper field is the most steadily remunerative and permanent mining district to be found on the globe.

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Assessments.

Assessments on Dividend-Paying Michigan Copper Mines.

In the following table the assessments levied on all mines credited with dividend payments are given, also dividends and profit and loss balances, showing that some of the dividends have been rather dearly obtained:

Mine.	Assessments.	Dividends.	Profit.	Loss.
Atlantic	$ 980,000	$ 780,000	.....	$ 200,000
Cliff	111,000	2,518,620	$ 2,407,620	.....
Calumet & Hecla	1,200,000	65.850,000	64,650,000	.....
Central	100,000	1,970,000	1.870,000	.....
Copper Falls	1,000,000	100,000	.....	900,000
Franklin	220,000	1,240,000	1,020,000	.....
Kearsarge	180,000	160,000	.....	20,000
Minnesota	456,000	1,820,000	1,364,000	.....
National	320,000	320,000	.....	.....
Osceola	1,700,000	3,094,500	1,394,500	.....
Phœnix	937,500	20,000	.....	917,500
Pewabic	585,200	1,000,000	414,800	.....
Quincy	200,000	11,420,000	11,220,000	.....
Ridge	470,000	100,000	.....	370,000
Tamarack	320,000	6,270,000	5,950,000	.....
Wolverine	230,000	270,000	40,000	.....
Totals	$9,009,700	$96,933,120	$90,330,920	$2,407,500

Assessments on Lake Superior Copper Mining Stocks.

All is not gold that glitters, and all copper mines in Michigan do not pay profits. Even the profit-paying mines required assessments before they arrived at the lucrative stage of their existence. A complete record of dividends has been given in the preceding table, but a complete record of assessments is absolutely unobtainable. Companies of all sorts have been formed in the past 56 years, and money raised for mining work. Mines have been opened in conglomerates, amygdaloids, sandstones and trap rock—in places where copper was found; where it seemed reasonable that the metal might be found, and in places where it never could be found by any possibility. Money has been carefully expended on worthless prospects, and wasted on good

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properties; some funds raised by assessment have been expended with care; others with recklessness and dishonesty, in opening mines in the wrong places, in building mills where no mine existed, in high salaries to greedy officials, and in the thousands of ways that offer themselves to those having the handling of other people's money. The following table shows the assessments levied on a considerable number of companies, including subscription price of stock in case of the newer companies. In addition to the totals given, from ten to fifteen millions should be added for money raised by assessment on the shareholders of properties now moribund, or even dead and long forgotten.

Company.	Total Assessments.
Adventure	$ 800,000
Allouez	1,616,000
Atlantic	980,000
Arcadian	1,800,000
Arnold	810,000
Baltic	500,000
Cliff	111,000
Calumet & Hecla	1,200,000
Centennial (old)	1,365,000
Centennial (new)	520,000
Copper Range	1,250,000
Central	100,000
Copper Falls	1,000,000
Elm River	800,000
Franklin	220,000
Humboldt	120,000
Huron	240,000
Isle Royale Consolidated	2,000,000
Kearsarge	180,000
Mass Consolidated	900,000
Mayflower	500,000
Meadow	36,750
Michigan	350,000
Miners	1,000,000
Mohawk	1,000,000
Minnesota	456,000
National	320,000
Old Colony	800,000
Osceola Consolidated	1,700,000
Phoenix (old)	937,500
Pewabic	585,200
Quincy	200,000
Ridge	470,000
Rhode Island	500,000
Tamarack	320,000
Tamarack Junior	640,000
Tecumseh	200,000
Trimountain	1,200,000
Victoria	800,000
Winona	800,000
Wolverine	230,000
Wyandot	700,000
Total	$30,257,450

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Capitalization of Mining Companies.

Authorized and Issued Capital Stock of the Lake Superior Copper Mining Companies.

The following table shows number of shares authorized, number issued, and total capitalization of the active Lake Superior copper mining corporations:

Name of Company.	Organized under Laws of.	No. Shares Authorized.	No. Shares Issued.	Gross Capitalization.
Adventure	Mich.	100,000	100,000	$2,500,000
Allouez	Mich.	100,000	80,000	2,500,000
Arcadian	N. J.	150,000	150,000	3,750,000
Arnold	Mich.	100,000	100,000	2,500,000
Atlantic	Mich.	40,000	40,000	1,000,000
Ash Bed	Mich.	40,000	40,000	1,000,000
Baltic	Mich.	100,000	100,000	2,500,000
Calumet & Hecla	Mich.	100,000	100,000	2,500,000
Centennial	Mich.	100,000	90,000	2,500,000
Central	Mich.	20,000	20,000	500,000
Copper Range	Mich.	100,000	100,000	2,500,000
Champion	Mich.	100,000	.....	2,500,000
Elm River	N. J.	100,000	100,000	2,500,000
Franklin	Mich.	100,000	80,000	2,500,000
Humboldt	Mich.	40,000	40,000	1,000,000
Isle Royale Consolidated	N. J.	150,000	150,000	3,750,000
Mohawk	Mich.	100,000	100,000	2,500,000
Mayflower	Mich.	100,000	100,000	2,500,000
Mass Consolidated	Mich.	100,000	100,000	2,500,000
Michigan	Mich.	100,000	100,000	2,500,000
Meadow	Mich.	60,000	60,000	1,500,000
National	Mich.	100,000	40,000	2,500,000
Old Colony	Mich.	100,000	100,000	2,500,000
Osceola	Mich.	100,000	93,000	2,500,000
Quincy	Mich.	100,000	100,000	2,500,000
Rhode Island	Mich.	100,000	100,000	2,500,000
Tamarack	Mich.	60,000	60,000	1,500,000
Tecumseh	Mich.	100,000	40,000	2,500,000
Trimountain	Mich.	100,000	100,000	2,500,000
Union C. L. and M	Mich.	100,000	80,000	2,500,000
Victoria	Mich.	100,000	100,000	2,500,000
Winona	Mich.	100,000	100,000	2,500,000
Washington	Mich.	100,000	60,000	2,500,000
Wolverine	Mich.	60,000	60,000	1,500,000
Wyandot	Mich.	100,000	100,000	2,500,000
Total Capitalization				$81,000,000

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Fluctuation of Copper Shares.

HIGHEST AND LOWEST PRICES FOR LAKE SUPERIOR COPPER MINING SHARES IN 1899.

Company.	Lowest.		Highest.	
Adventure	$ 5.50	Oct. 26	$ 18.12	Feb. 23
Allouez	3.00	Dec. 18	13.50	Feb. 20
Arcadian (N. J. Co)	18.00	Dec. 14	79.87	Aug. 8
Arnold	4.00	Dec. 18	17.25	Jun. 13
Atlantic	21.00	Dec. 12	45.00	Jan. 30
Baltic	16.50	Dec. 23	36.75	Apr. 20
Calumet & Hecla	635.00	Jan. 6	895.00	Feb. 21
Centennial	14.00	Dec. 18	61.00	Mch. 4
Copper Range	25.00	Dec. 30	51.00	Apr. 6
Franklin	11.00	Dec. 18	30.00	Feb. 2
Humboldt	1.00	Dec. 20	3.75	Jan. 3
Isle Royale (N. J. Co.)	21.00	Dec. 14	75.00	Apr. 11
Mass	9.00	Dec. 13	17.00	Apr. 26
Mayflower	2.75	Dec. 22	10.25	Apr. ..
Michigan	6.00	Dec. 27	19.00	Feb. ..
Mohawk	14.00	Dec. 28	38.25	Apr. 3
Old Colony	3.50	Dec. 11	21.50	Feb. 23
Osceola	61.00	Dec. 14	105.00	Feb. 18
Quincy	130.00	Dec. 18	190.00	Jan. 26
Rhode Island	4.25	Dec. 22	16.00	Feb. 24
Tamarack	170.00	Dec. 28	265.00	Feb. 23
Tecumseh	3.25	Dec. 28	10.25	Feb. 21
Trimountain	5.75	Dec. 27	14.50	Apr. 21
Union C., L. & M.	2.50	Dec. 18	13.50	Jan. 9
Victoria	3.00	Dec. 19	11.00	Feb. ..
Washington	1.00	Dec. 16	4.25	Feb. 20
Winona	4.00	Dec. 29	22.00	Feb. 21
Wolverine	34.50	Dec. 14	50.00	Feb. 20
Wyandot	1.50	Dec. 23	11.00	Feb. ..

In several cases in the preceding table, where the month but not the day of the highest price is given, the high price was obtained on the "curb," preceding the listing of the stock, the listing being a necessary preliminary to the shares of any corporation being dealt in regularly, on the floor of the Boston Stock Exchange. A curb market is where seller and buyer get together as best they can, and where no regular records of transactions are kept, and no supervision of sales is exercised by the stock exchange, or any other governing body.

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SHRINKAGE IN VALUE OF LAKE SUPERIOR COPPER MINING SHARES.

Mine.	High Price 1899.	Market Price Aug., 1900.	Shrinkage.
Adventure	18½	3½	$ 1,462,500
Allouez	13½	1⅛	1,237,500
Arcadian	80	19	9,150,000
Arnold	19	4	600,000
Ashbed	4	¼	1,400,000
Atlantic	45	24	840,000
Baltic	36½	20	1,650,000
Calumet & Hecla	895	745	15,000,000
Copper Range	55	19	3,600,000
Elm River	18	3½	1,450,000
Franklin	30	13⅛	1,625,000
Humboldt	2	¼	700,000
Isle Royale	75	28½	4,650,000
Miners'	45	....	4,500,000
Mass	17	6¼	1,075,000
Michigan	19	3	1,600,000
Mohawk	38½	17⅛	2,112,500
Mayflower	8½	2	650,000
Old Colony	21½	3	1,850,000
Osceola	105	67	3,800,000
Quincy	190	140	5,000,000
Rhode Island	17	2½	1,450,000
Tamarack	265	213	3,120,000
Tecumseh	10	2½	600,000
Trimountain	14½	8½	600,000
Union Copper L. & M. Co.	13½	2	1,150,000
Victoria	11½	2	950,000
Winona	22	3	1,900,000
Wolverine	50	40	600,000
Washington	4½	⅜	700,000
Wyandot	11½	1½	1,000,000
Calumet & Hecla	895	745	15,000,000
Total			$76,012,500

This is a shrinkage of about 40 per cent from the top prices of February, 1899.

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Sales of Copper Shares.

TRANSFERS OF LAKE SUPERIOR COPPER SHARES IN 1899.

The following table shows sales of stock of Lake Superior copper mining companies made on the Boston stock exchange, during the year 1899:

Mine.	No. Shares Sold.
Centennial	477,683
Arcadian	263,287
Isle Royale	228,389
Mohawk	167,900
Franklin	155,349
Old Colony	145,704
Osceola	142,987
Baltic	131,961
Arnold	128,228
Allouez	119,066
Rhode Island	108,052
Washington	107,270
Winona	105,435
Wolverine	101,578
Adventure	83,154
Atlantic	61,927
Tecumseh	47,087
Copper Range	37,971
Trimountain	33,113
Victoria	26,952
Mass	25,894
Calumet & Hecla	21,831
Ashbed	21,205
Quincy	20,892
Tamarack	19,864
Michigan	16,342
Wyandot	14,576
Humboldt	13,724
Mayflower	7,670
Total	2,835,101

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Mine Forces and Accidents.

NUMBER OF MEN EMPLOYED BY MICHIGAN COPPER MINES, 1889 TO 1899.

The number of men employed by the copper mines, mills and smelters of Houghton county, is shown in the following table. The figures are from the censuses taken annually, in September, by Capt. Josiah Hall, mine inspector of Houghton county, for the years 1889 to 1900, inclusive.

Year.	No. Employees	No. Fatal Accidents.	Per Cent Fatal Accidents.
1889	6,480	21	.30
1890	7,310	35	.48
1891	7,702	28	.36
1892	7,640	21	.27
1893	7,591	23	.30
1894	7,348	22	.30
1895	7,249	46	.63
1896	8,170	19	.23
1897	8,726	26	.30
1898	10,469	23	.22
1899	13,051	27	.20
1900	13,971	—	—

This gives a total of 291 fatal accidents in eleven years, an average of 26½ deaths per year, with an average percentage for eleven years of 3.26 deaths per thousand employees, from accident. The showing is one of the best made by any mining field in the world. The managements of the various mines do all in their power to render underground work as safe as possible, expending money freely to this end; and the greater number of the fatal accidents are caused by the carelessness of the men meeting their deaths. Familiarity with underground dangers often breeds contempt, which is apt to be followed by serious consequences. A gratifying feature of the exhibit is the lessened percentage of fatal accidents within the past few years. In 1889 there were 21 fatal accidents in 6,480 employees, while in 1899, with more than twice as many workmen, there were but 27 men killed. The casualty list for 1893 would have been the smallest for a quarter of a century, but for the negligence of an engineer at the Red Jacket shaft of the Calumet & Hecla. The indicator dropped from

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the sprocket chain on the engine and the engineer heedlessly kept on winding the cable around the drum, as a result of which ten men were dropped about 3,300 feet, down a vertical shaft. Similarly, the loss of life in 1895 would have been the smallest of any year for two decades, but for the suffocation of 30 men and boys by gas from a fire in the Osceola mine, in September of that year. This last accident can be properly ascribed neither to any neglect of the management nor to gross carelessness on the part of the victims, though all were warned in ample time to have gotten out in safety. There was so little timber in the mine, that no possible danger to life could come from fire, and the deadly effect of the gas resulting from the under-combustion of the wood was unanticipated by either management or miners. The asphyxiation of the Osceola victims has at least served the good purpose of setting managers and mine employees on their guard against underground fires, no matter how trivial they may seem. The slightest fire is now followed by a general alarm, and it is instantly heeded by every man below surface.

The ratio of increase in mine forces over the preceding year was 12 per cent in 1896; nearly 7 per cent in 1897; almost exactly 20 per cent in 1898; very nearly 25 per cent in 1899, and for 1900 will be about 9 per cent.

In addition to the figures for Houghton county, 750 men should be added for mine employees of Keweenaw and Ontonagon counties, with every prospect that this number will be increased four-fold within a very few years. The Houghton county mines have by no means reached the limit of their productive capacity and it is probable that nearly or quite 20,000 men will be employed by Michigan copper mines within five years.

The foregoing figures are only for men employed directly by the mines, mills and smelters. No account is taken of the large number of railway employees, machinists and founders in iron working establishments supplying the mines, and many other classes of labor dependent directly on the mines for a livelihood, although not carried on the payrolls of the mining companies. The mines also give employment to several thousand men in the forests and mills, cutting and dressing timber and wood; to a considerable fleet of vessels, ranging from the little tugs engaged in towing rafts to big freighters carrying the Calumet & Hecla mineral from Lake Linden to Buffalo. Fully a thousand miners, railway men and sailors are engaged in the mining and transporting of the half million tons of coal required annually to furnish power for the copper mines. It is probable that the Lake Superior copper mines furnish employment, directly and indirectly, to about 30,000 men in the actual turning out of the ingots of metal, and that an equal number are employed in the various brass and copper manufactories of the United States which work the crude metal into finished forms. Furthermore, the dividends of these mines for the year 1899 would have furnished an annual income of $500 each, to 24,636 heads of families.

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Shareholders of Copper Mines.

SHAREHOLDERS OF LAKE SUPERIOR COPPER MINING COMPANIES, 1895 to 1899.

The following table gives the number of shareholders of the active Lake Superior copper mining companies, for the years 1895 to 1899, inclusive. The first total is given to show the complete number of shareholders of the companies that have been active for some years, while the second total includes the numerous new corporations organized in 1898 and 1899, and reporting in the latter year for the first time:

Company.	1899	1898	1897	1896	1895
Calumet & Hecla	2,859	2,716	2,590	2,464	2,458
Osceola	1,522	1,477	900	823	1,023
Quincy	1,449	1,445	1,041	978	907
Tamarack	1,157	1,353	1,371	1,178	1,140
Wolverine	688	625	445	333	218
Franklin	550	442	461	458	473
Centennial	337	438	....	...	....
Atlantic	300	401	400	364	385
Tamarack Jr.	....	....	600	575	591
Kearsarge	....	...	312	301	467
First total	8,862	8,897	8,120	7,474	7,652
Baltic	486	..	....	....	....
Winona	468	....	....	....	....
Allouez	449	....	....	....	....
Adventure	431	....	....	....	....
Arnold	403	....	....	....	....
Arcadian	301	....	....	....	....
Central	196	....	....	....	....
Rhode Island	97	....	....	....	....
Meadow	96	...	....	....	....
Mohawk	61	....	...	....	....
Michigan	22	....	....	....	....
Grand total	11,872	8,897	8,120	7,474	7,652

Including companies not reporting, and allowing for natural increase in shareholders, there are between 20,000 and 25,000 shareholders of the various Lake Superior copper mining companies at the present time.

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Summary of Calumet & Hecla Shareholders.

The Calumet & Hecla is not only the most valuable mine of the Lake Superior district, but of the entire world, exceeding all mines of copper, silver, gold and diamonds in earnings and the market value of the mine. Before July 1, 1901, it probably will have paid a greater sum in dividends than any other mine has ever disbursed. Although it has 100,000 shares, of the par value of $25 each, the market value of these shares has remained very closely around $750 each, for the first eight months of the year 1900. A concise summary of the location and holdings of its shareholders may be of interest.

The stock of the company is owned in about 30 different states. About 75 per cent is owned in New England, and about two-thirds of the total stock issue is held in Boston and its suburbs. There are 83 shareholders in foreign countries, owning 2,925 shares of stock, worth nearly two and a quarter millions, and on which dividends of almost one thousand dollars per day for every business day of the year were paid in 1899, these foreign holdings being distributed as follows:

Country.	No. Owners.	Total No. Shares.
Canada	39	1,622
England	31	547
France	6	396
Germany	2	125
Italy	2	17
India	1	10
Scotland	1	4
Ireland	1	4
Totals	83	2,925

Michigan shareholders of record are as follows:

Section.	No. Owners.	No. Shares.
Copper District	394	8,138
Detroit	42	6,409
Balance Lower Peninsula	50	977
Balance Upper "	33	303
Total	519	15,827

The holdings of the copper district, comprising the three counties of Houghton, Ontonagon and Keweenaw, are as follows:

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Place.	No. Owners.	No. Shares.	Value.
Calumet	170	3,742	$ 2,806,500
Hancock	53	1,416	1,062,000
Houghton	39	1,151	863,250
Lake Linden	45	676	507,000
Opechee	8	309	231,750
So. Lake Linden	9	248	186,000
Laurium	12	152	114,000
Eagle River	14	125	93,750
Central Mine	11	107	80,250
Rockland	7	98	73,500
Allouez	5	58	43,500
Atlantic Mine	4	26	19,500
Eagle Harbor	2	15	11,250
Copper Falls	2	8	6,000
Kearsarge	1	3	2,250
Phoenix	1	2	1,500
Redridge	1	2	1,500
Totals	394	8,138	$6,103,500

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American Copper Production.

VALUE AMERICAN COPPER PRODUCTION, 1887 TO 1899.

The government estimates of the market value of the copper produced by American mines for the past 13 years is as follows. I have modified the figures for 1899 in accordance with exact statistics showing that the government estimate of Michigan production was much too high:

Year.	Lbs. Refined Copper.	Market Value.
1887	185,227,331	$ 21,115,916
1888	231,270,622	33,833,954
1889	231,246,214	26,907,809
1890	265,115,133	30,848,797
1891	295,812,076	38,455,300
1892	352,971,744	37,977,142
1893	339,785,972	32,054,601
1894	364,866,808	33,141,142
1895	392,639,964	38,682,347
1896	460,061,430	49,456,603
1897	494,078,274	54,080,180
1898	526,375,591	61,849,132
1899	581,319,091	100,916,994

Despite the rapid gain in production and increase in prices noted within the past two years in nearly all lines of business in the United States, there is no other great industry in the country that produced an output in 1899 valued at more than three times the production of only five years previously.

PROPORTION OF COPPER TO TOTAL VALUE AMERICAN MINERAL PRODUCTION, 1888 TO 1899.

The following table gives the gross value of all American metals mined in the past twelve years; the value of copper products for the same years, and the percentage of total values made by the copper:

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Year.	Total Metallic Values.	Copper Values.	Percentage Copper of Total.
1888	$253,731,822	$ 33,833,954	15
1889	267,247,033	26,907,809	10
1890	305,735,670	30,848,797	10
1891	300,232,798	38,455,300	13
1892	307,716,239	37,977,142	12
1893	249,981,866	32,054,601	13
1894	218,168,788	33,141,142	15
1895	281,913,639	38,682,347	14
1896	287,596,906	49,456,603	17
1897	302,198,502	54,080,180	18
1898	344,079,986	61,849,132	18
1899	496,057,320	100,916,994	20

Remarkable as has been the increase in the production and value of nearly all American metals mined in the past decade, none other can approach the showing made by copper. In 1889 the proportion of the value of copper to the total value of American metals mined was 10 per cent, while ten years later it was double that amount. In the decade ending with 1899, the value of the gross metal production of the United States nearly doubled, while the value of the copper product nearly quadrupled. Copper was mined in 1899 to a greater value than any other metal in the United States, leading gold, silver at coinage value, and iron ore. The only metal produced to a greater value in 1899 was pig iron, two-thirds of the value of which was added at the furnaces, while in the case of the copper, only 2 to 10 per cent was added to the value in the process of smelting. In all years since 1892, until 1899, the value of the American gold product exceeded the value of the copper production, but in 1899 copper exceeded gold in value by very nearly 50 per cent.

United States Copper Production by States in 1898.

The following table gives detailed figures, in pounds, of the production of refined copper by the leading districts of the United States, in the year 1898:

State.	Pounds Refined Copper.
Montana	206,173,157
Michigan	147,965,738
Arizona	111,158,246
California	16,925,634
Colorado	16,274,561
Utah	3,750,000
New Mexico	1,592,371
Idaho	1,266,920
South Dakota	1,261,393
Nevada	437,396
Wyoming	233,044
Miscellaneous	8,948,562
Total	**515,987,022**

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American Production of Copper for First Six Months of 1900.

Figures of production of copper by mines of the United States for the first six months of 1900, as compared with the first six months of 1899, show a considerable gain, amounting to about 8 per cent. The estimated production of the balance of the world is a few hundred tons less than for the first half of 1899. Figures of estimated production of American mines for the first half years of 1899 and 1900, by months, in long tons, are as follows:

Month	1900	1899.
January	21,013	18,624
February	20,897	19,899
March	23,283	21,918
April	24,067	19,954
May	22,682	22,082
June	22,635	22,010
Totals	134,580	124,487

Percentage of Increase in American Copper Production 1888 to 1899.

The following table shows the annual increase or decrease in copper production by mines of the United States for the past twelve years, the percentages being figured from the statistics of the government geological bureau:

Year.	Per Cent Increase.	Per Cent Decrease.
1888	25.	..
1889	..	.01
1890	14.	..
1891	11.	..
1892	19.	..
1893	..	1.5
1894	7.	..
1895	8.	..
1896	17.	..
1897	7.	..
1898	6.5	..
1899	10.5	..

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American Copper Consumption.

DOMESTIC CONSUMPTION OF COPPER, 1893 TO 1898.

In the following table the first column shows the production of refined copper by the United States, the second column gives exports, and the third column gives the difference between production and exports, being the quantity remaining for domestic consumption, all figures being in long tons:

Year.	U. S. Production.	Exports.	Domestic Consumption.
1893.....	142,480	80,392	62,088
1894.....	159,623	77,131	82,492
1895.....	171,197	64,722	106,475
1896.....	203,894	125,605	78,289
1897.....	216,106	129,210	86,896
1898.....	234,272	145,115	89,157

The production of the United States increased 64 per cent in the five year period from 1893 to 1898, and in the same period exports increased 80 per cent, and the domestic consumption, based on production remaining unexported, increased nearly 44 per cent.

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American Copper Exports.

AMERICAN EXPORTS OF COPPER, 1864 TO 1898.

The government estimates of exports of copper, including ingot and various forms of refined copper, matte, blister copper and ores, and manufactured products, from 1864 until 1898, inclusive, are as follows:

Year Ending—	Ore and Matte.	Refined.	Total Value.
	Cwts.	*Pounds.*	
June 30, 1864	109,581	102,831	$ 432,570
1865	225,197	1,572,382	1,544,870
1866	215,080	123,444	936,211
1867	87,731	4,637,867	791,901
1868	92,612	1,350,896	922,409
1869	121,418	1,134,360	592,698
1870	19,198	2,214,658	1,042,246
1871	54,445	581,650	915,431
1872	35,564	267,868	287,735
1873	45,252	38,958	259,076
1874	13,326	503,160	467,208
1875	51,305	5,123,470	1,815,266
1876	15,304	14,304,160	3,526,410
1877	21,432	13,461,553	3,023,394
1878	32,947	11,297,876	2,488,921
1879	23,070	17,207,739	2,933,205
1880	21,623	4,206,258	849,218
1881	9,958	4,865,407	876,395
1882	25,936	3,340,531	748,456
1883	112,923	8,221,363	2,348,004
1884	386,140	17,044,760	5,595,859
1885	432,300	44,731,858	10,187,024
Dec. 31, 1886	417,520	19,553,421	4,386,322
1887	501,280	12,471,393	4,114,456
1888	794,960	31,706,527	11,897,240
1889	818,500	16,813,410	10,209,722
1890	431,411	10,971,899	5,918,395
1891	672,120	69,279,024	15,703,543
1892	943,040	30,515,736	10,162,870
1893	835,040	138,984,128	18,935,497
1894	87,040	162,393,000	16,143,094
1895	276,480	121,328,390	14,938,309
1896	414,265	259,223,924	31,035,211
1897	181,280	277,255,742	32,755,053
1898	186,860	291,955,905	35,545,251

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American Exports of Refined Copper, 1893 to 1898.

The following figures, showing American exports of copper, in long tons, from 1893 to 1898, inclusive, are furnished by Mr. John Stanton, of New York, secretary of the American Copper Producer's Association, and unquestionably the foremost American authority on the copper trade:

Year.	Exports—long tons.
1893	80,392
1894	77,527
1895	64,722
1896	125,605
1897	129,210
1898	145,115

American Copper Exports for First Half of 1900.

Copper exports from the United States for the first six months of 1900 have been as follows:

Month.	Long tons.
January	14,035
February	12,749
March	20,148
April	12,762
May	13,997
June	16,586
Total	90,277

American Copper Exports, First Half Years, 1896 to 1900.

Copper exports from the United States for the first half of 1900, and the first six months of each of the preceding four years have been as follows:

First Half Year.	Exports—Long Tons.
1896	58,318
1897	64,870
1898	68,284
1899	56,460
1900	90,277

The American exports for the first half of the year 1900 were 60 per cent greater than the exports of the corresponding period in 1899, and 45 per cent in excess of the average exports of the first half of the years 1896 to 1899, inclusive.

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American Copper Exports by Ports, for 1898.

The exports of copper for the year 1898 were made from the following named ports, figures being in pounds:

Port.	Exports.
New York	178,400,814
Baltimore	87,027,133
New Orleans	15,508,831
Norfolk	5,249,820
Newport News	2,638,868
Detroit	728,689
Newark	673,180
Galveston	444,920
Boston	439,368
Burlington, Vt.	410,410
Port Huron, Mich.	118,827
Miscellaneous	315,545
Total	291,955,905

American Copper Exports, by Destinations, 1899.

For the fiscal year ending June 30, 1899, the exports of copper matte, at 55 per cent refined metal, were 7,281,120 pounds, of which 1,985,984 lbs. were sent to Great Britain. The exports of refined coppes, in ingots, bars, cakes and molds, were as follows:

Destination.	Lbs.
Great Britain and Ireland	72,722,558
France	48,172,635
Germany	44,600,972
Balance Europe	87,938,298
Canada	1,133,038
Mexico	266,734
Other countries	152,844
Total	254,987,079

The value of the average annual exports of the past three years has exceeded the value of all importations of copper into the United States, for domestic consumption, since the formation of the Union.

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English Copper Statistics.

English Copper Imports, Exports and Consumption, 1860 to 1898.

The following table, issued by the United States Geological Survey, gives figures of English imports, exports and apparent consumption from 1860 until 1898, inclusive. As England has been the principal copper market of the world, and has fixed the price of the metal until very recently, the figures are valuable:

Year.	Long Tons.				
	Imports of—		Total imports.	Exports.	Apparent English consumption.
	Bars, cakes, and ingots.	Copper in ores and furnace products.			
1860	13,142	13,715	26,857	26,117	.....
1865	23,137	23,922	47,059	41,398	.....
1870	30,724	27,025	57,749	53,006	.....
1871	33,228	23,671	56,899	56,633	.....
1872	49,000	21,702	70,702	53,195	.....
1873	35,840	26,756	62,596	55,716	.....
1874	39,906	27,894	67,800	59,742	.....
1875	41,931	29,483	71,414	51,870	.....
1876	39,145	36,191	75,336	52,468	.....
1877	39,743	53,582	93,325	54,088	.....
1878	39,360	48,212	87,572	55,001	.....
1879	46,670	50,421	97,091	62,412	30,774
1880	36,509	56,225	92,734	59,482	32,879
1881	32,170	54,057	86,227	61,689	31,607
1882	35,509	58,366	93,875	55,683	42,877
1883	35,653	63,493	99,146	59,350	40,469
1884	39,767	69,623	109,390	64,691	51,263
1885	41,933	81,616	123,549	62,080	54,323
1886	42,969	65,046	108,015	60,511	41,158
1887	29,198	73,891	103,089	69,453	53,096
1888	44,063	90,867	135,470	a72,066	42,562
1889	b38,576	101,407	139,983	75,627	65,759
1890	c49,461	91,788	141,249	89,747	66,170
1891	44,213	94,403	138,616	76,056	59,223
1892	d35,015	99,356	134,371	82,542	e48,367
1893	41,829	88,003	129,832	70,986	66,817
1894	56,157	68,851	125,008	54,689	61,330
1895	42,135	77,806	119,941	65,990	62,692
1896	60,458	75,398	135,856	59,334	89,191
1897	60,428	76,127	136,555	56,542	84,631
1898	67,978	71,726	139,704	63,256	76,448

a Including 22,557 tons of Chile bars transferred to France
b Including 1,166 tons of Chile bars transferred from France to England.
c Including 3,501 tons of Chili bars transferred from France to England.
d Including 3,585 tons of Chile bars transferred from France to England.
e Add 4,001 tons for comparison with former years, the difference arising from the new method of making up stock.

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Visible Supply of Copper, 1890 to 1900.

In England an account is kept of all copper in stock at London and Liverpool, England; Swansea, Wales; and Havre, France. To this is added the cargoes of copper afloat to British ports, as per mail and cable advices. The figures so reached are known as the Visible Supply of copper, in Europe. All figures are in long tons:

Date.	Visible Supply.
Jan. 1, 1890	98,847
Jan. 1, 1896	45,817
Jan. 1, 1897	34,927
Jan. 1, 1898	31,955
Jan. 1, 1899	27,913
Jan. 1, 1900	22,985
Apr. 1, 1900	24,948
June 1, 1900	22,354
July 1, 1900	29,298
Aug. 1, 1900	28,912
Aug. 15, 1900	32,504

English Copper Prices, 1880 to 1899.

The following table gives the lowest and highest prices of G. M. B. (good merchantable brands) copper in London, for each of the past twenty years. Prices are in pounds, shillings and pence, and for long tons, of 2,240 pounds weight:

Year.	Lowest. £ s. d.	Highest. £ s. d.	Fluctuation. £ s. d.
1880	54 10 0	74 0 0	19 10 0
1881	57 0 0	72 10 0	15 10 0
1882	63 0 0	71 10 0	8 10 0
1883	57 0 0	67 10 0	9 10 0
1884	47 5 0	58 0 0	10 15 0
1885	38 10 0	61 12 6	23 2 6
1886	38 10 0	43 15 0	5 5 0
1887	38 7 6	85 5 0	46 17 6
1888	73 0 0	105 0 0	32 0 0
1889	35 0 0	80 0 0	45 0 0
1890	46 10 0	61 12 6	15 2 6
1891	44 1 3	56 10 0	12 8 9
1892	43 10 0	47 18 9	4 8 9
1893	40 12 6	46 16 3	6 3 9
1894	37 17 6	43 0 0	5 2 6
1895	38 13 9	47 8 9	8 15 0
1896	40 10 0	50 8 9	9 18 9
1897	47 0 0	51 15 0	4 15 0
1898	49 5 0	57 8 9	8 3 9
1899	58 1 3	79 2 6	21 1 3

The highest price was in 1888, when the Secretan syndicate put the screws on the market and forced the price above £100, for the first time in nearly twenty years. The lowest price ever recorded was in

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1889, immediately after the collapse of the Secretan syndicate, when G. M. B's dropped to an even £35 on the London Metal Exchange. The greatest fluctuation recorded was in 1887, when copper more than doubled in price—this also being due to the manipulation of the same Societè des Metaux, better known as the Secretan syndicate.

Table for Reducing English into American Prices.

The following table shows the corresponding value in cents and fractions, per pound, of copper quoted at various prices from £35—the lowest quotation ever made—to £100 per long ton, exchange being figured on the basis of $4.85 as equal to one pound sterling:

English Price in Pounds Sterling.	American Prices in Cents and Fractions.	English Price in Pounds Sterling.	American Prices in Cents and Fractions.
35	7.57	68	14.72
36	7.79	69	14.93
37	8.01	70	15.15
38	8.22	71	15.37
39	8.44	72	15.58
40	8.66	73	15.80
41	8.87	74	16.02
42	9.09	75	16.23
43	9.31	76	16.45
44	9.52	77	16.67
45	9.74	78	16.88
46	9.95	79	17.10
47	10.17	80	17.32
48	10.39	81	17.53
49	10.60	82	17.75
50	10.82	83	17.97
51	11.04	84	18.18
52	11.25	85	18.40
53	11.47	86	18.62
54	11.69	87	18.83
55	11.90	88	19.05
56	12.12	89	19.27
57	12.34	90	19.48
58	12.55	91	19.70
59	12.77	92	19.92
60	12.99	93	20.13
61	13.20	94	20.35
62	13.42	95	20.56
63	13.64	96	20.78
64	13.85	97	21.00
65	14.07	98	21.21
66	14.29	99	21.43
67	14.50	100	21.65

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World's Copper Production.

COPPER PRODUCTION OF WORLD'S LARGEST MINES FOR 1898.

The following table, carefully compiled, wherever possible from the figures of the official reports of the companies themselves, gives the production of the world's largest mines, in long tons, for the year 1898. There are perhaps several other producers of 3,000 tons or more annually, from which no data is obtainable. The estimate of 8,040 tons of copper from Canadian mines for 1898 is accepted by all the authorities, but data in detail is not given by any of them. The Butte & Boston probably belongs in the list of mines producing upwards of 3,000 tons annually, but the production is so effectually concealed that I have preferred making no estimate whatever, as any figure that I could possibly give would be the merest guesswork. The figures in this table given in round numbers are estimates, but are fair approximations of the actual outputs:

No.	Mine.	Location.	1898 Product—Long Tons.
1.	Anaconda	Montana	50,000
2.	Calumet & Hecla	Michigan	38,583
3.	Rio Tinto	Spain	33,882
4.	Boston & Montana	Montana	30,000
5.	United Verde	Arizona	18,896
6.	Mansfeld	Germany	18,045
7.	Copper Queen	Arizona	15,066
8.	Tharsis	Spain	11,147
9.	Boleo	Mexico	9,435
10.	Tamarack	Michigan	8,777
11.	Mountain Copper	California	8,273
12.	Arizona Copper Co	Arizona	8,111
13.	Besshi	Japan	8,000
14.	Ashio	Japan	7,500
15.	Quincy	Michigan	7,301
16.	Montana Ore Pchg. Co.	Montana	6,300
17.	Osceola	Michigan	5,661
18.	Parrot	Montana	5,555
19.	Wallaroo & Moonta	Australia	5,500
20.	Detroit	Arizona	5,102
21.	Mt. Lyell	Tasmania	5,000
22.	Ookiep	Cape Colony	4,920
23.	Mason & Barry	Portugal	3,500
	Total for 23 mines		314,554

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These 23 mines made 72 per cent of the world's production of 432,905 long tons of copper in the year 1898. Of these 23 mines the United States has 13, or more than half, these, in order of size, being Nos. 1, 2, 4, 5, 7, 10, 11, 12, 15, 16, 17, 18 and 20. Spain comes second on the list with Nos. 3 and 8. Japan has two, Nos. 13 and 14, no other country having more than one. Germany has No. 6; Mexico No. 9; Australia No. 19; Tasmania No. 21; Cape Colony No. 22 and Portugal No. 23.

Of the four states of the union represented in this list, Montana takes precedence with four mines, Nos. 1, 4, 16 and 18; Michigan comes second with Nos. 2, 10, 15 and 17, Arizona third with Nos. 5, 7, 12 and 20, while California has a single producer, No. 11, on the list of the world's greatest copper mines.

World's Copper Production, 1880 to 1899.

The following table gives round figures of the world's production of copper in long tons for the past twenty years, with percentage of the total production made by the United States:

Year.	U. S.	Foreign.	Total.	Per Cent of U. S.
1880	27,000	127,000	154,000	17
1881	32,000	131,000	163,000	19
1882	40,000	141,000	181,000	22
1883	51,000	148,000	199,000	24
1884	64,000	156,000	220,000	29
1885	74,000	151,000	225,000	32
1886	70,000	147,000	217,000	32
1887	81,000	143,000	224,000	36
1888	101,000	157,000	258,000	39
1889	101,000	160,000	261,000	38
1890	116,000	153,000	269,000	43
1891	127,000	152,000	279,000	45
1892	154,000	156,000	310,000	49
1893	147,000	156,000	303,000	48
1894	158,000	166,000	324,000	49
1895	170,000	164,000	334,000	50
1896	204,000	169,000	373,000	54
1897	216,000	182,000	398,000	54
1898	234,000	200,000	434,000	54
1899	265,000	209,000	474,000	56

In this period of twenty years the world's production has increased 207 per cent. The production of the United States has increased 881 per cent; the production of Michigan 194 per cent; and the foreign mines collectively, only 64 per cent.

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World's Copper Production, by Continents, 1889 to 1898.

For the ten-year period from 1889 to 1898, inclusive, the world's production of copper is estimated as follows, by grand divisions of the earth, all figures being in long tons, with fractions omitted:

Division.	1889.	1890.	1891.	1892.	1893.
North America	110,674	124,711	138,065	166,941	158,553
Europe	81,613	79,952	80,751	84,648	82,922
South America	31,983	33,960	29,015	29,015	27,320
Asia	16,125	17,972	18,500	19,000	18,000
Australia	11,582	9,455	10,292	8,785	6,158
Africa	7,860	6,570	6,120	6,120	6,090
Totals	259,837	272,620	282,713	314,509	299,043

	1894.	1895.	1896.	1897.	1898.
North America	172,994	187,260	222,524	242,679	263,625
Europe	82,474	83,128	88,216	89,938	88,930
South America	26,810	24,925	26,340	25,300	30,065
Asia	20,050	18,430	21,000	23,000	25,175
Australia	6,791	8,573	11,272	16,778	18,000
Africa	6,500	7,115	7,450	7,440	7,110
Totals	315,619	329,431	376,802	405,135	432,905

These figures show an increase of 66⅔ per cent, or almost exactly two-thirds, in the world's production of copper, in the decade ending 1898. Of the actual increase of 173,068 tons, North America made 152,951 tons, or more than 88 per cent, and of this gain the United States made by far the greater share. The actual increase in the production of North American mines was 138 per cent. The Lake Superior mines produced 44,088 tons of copper in 1889 and 73,983 tons in 1898, an increase of 67⅞ per cent, or one and one-third per cent more than the percentage of increase of the entire world. Of the increase of 173,068 tons made by the entire world in the decennial period ending in 1898, the United States made 133,821 tons, or 77 per cent of the total increase of the world.

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World's Copper Production by Countries, 1898.

The production of copper of the world, by countries, for the year 1898, the latest for which detailed figures are obtainable, was as follows:

Country.	Long Tons.
United States	235,050
Spain	53,225
Japan	25,175
Chile	24,850
Germany	20,085
Mexico	18,435
Australia	12,000
Canada	8,040
South Africa	7,060
Russia	6,000
Tasmania	6,000
Norway	3,615
Italy	3,435
Peru	3,040
Newfoundland	2,100
Bolivia	2,050
Austro-Hungary	1,540
Great Britain	550
Sweden	480
Argentina	125
Algiers	50
Total	432,905

The commanding position of the United States as the producer of the world's copper supply is too plainly shown in the foregoing table to require extended comment. The United States furnished 54 per cent of the world's supply of copper in 1898, and is increasing its production much more rapidly than any other country, or than all other countries combined.

World's Copper Production for the Nineteenth Century.

The following table, showing the production of copper for the nineteenth century, with the exception of the last two years, and giving comparative figures and average price per ton in pounds sterling, is from the London Financial News of January, 1900, and was com-

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piled by Mr. R. Gervase Elwas. In this table, as in all others in this volume, where other than figures of exclusively domestic production are given, the quantities are in long tons, of 2,240 pounds each:

DECADE.	Average price rough copper.....	World's production of each decade	Increase of production over previous decade.....	Average annual production for each decade.....	Increase of average annual production.. .....
1801 to 1810	£160	91,000	.....	9,100	.....
1811 to 1820	130	96,000	5,000	9,600	500
1821 to 1830	101	136,000	39,000	13,500	3,900
1831 to 1840	94	218,400	83,400	21,840	8,340
1841 to 1850	83	281,000	72,600	29,100	7,200
1851 to 1860	111	505,999	214,999	50,600	21,500
1861 to 1870	87	900,000	394,001	90,000	39,400
1871 to 1880	79	1,189,400	289,400	118,940	28,940
1881 to 1890	60	2,215,900	1,026,500	221,590	102,650
1891 to 1898—eight years only.....	49	2,737,500	521,600	342,188	120,598
Grand total world's production		8,380,199			

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A Peep Into the Future.

WORLD'S COPPER REQUIREMENTS FOR THE TWENTIETH CENTURY.

The man who engages in prophecy is pursuing a dangerous avocation. The prophet is immune for the immediate present, but discredited prognostications have a habit of turning up in later years at most inopportune moments. Notwithstanding this fact, mankind must predicate the future by the developments of the past. The demand for all of the metals has increased marvelously during this century and is still increasing. The consumption of the basic metal, iron, is a test of civilization. In the United States the production of pig iron has approximately doubled every decade for the past sixty years. The supply of gold was never so great as now, and silver, despite its discredited condition, is being produced in greater quantities than ever before. Of the minor metals, nickel, which was little more than a curiosity at the beginning of the century, is now mined by the thousands of tons annually, and the demand is crowding the supply entirely too close for the comfort of consumers. Very few people, outside of those interested in the iron trade, know that manganese is an article of commerce, yet in the year 1898 more than 200,000 tons of manganese ore were mined, in addition to manganiferous iron ore—and the supply was insufficient. At the beginning of the century ten thousand tons of spelter would have overstocked the markets of the world so effectually that all the zinc mines would have suspended in sheer despair of the ability of the world to assimilate such an enormous tonnage, yet in 1898 the United States produced 115,399 tons of spelter, and Europe mined and refined 358,500 tons—a total of 473,899 tons for the world—a greater product than that of all the copper mines, though of only about one-third of the value of the copper product. The uses of zinc, as of other metals, have rapidly multiplied. In addition to sheet zinc for commercial use, it is an important factor in the making of white paint; it must be had for galvanizing iron, and it is absolutely essential in the cyanide process of gold extraction, without which not a mine on the South African Rand could earn a dollar, and lacking which more than two-thirds of the world's present supply of gold would remain unmined, because impossible of production at a profit. Last, but not least, zinc is the only negative metal, and without it the manifold electrical industries of the world, employing hundreds of thousands of men and using bil-

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lions of dollars of capital; lighting our streets, hauling our cars, carrying our messages and performing countless utilities for this utilitarian age—without zinc all this would stop.

The subject of zinc is scarcely germane to an article upon copper, yet it throws a side light upon the copper situation, by evidencing what a minor metal is doing and in what quantity it is being produced. Copper is not a minor metal, but one of the world's necessities—second only to iron, and scarcely to that, in our modern civilization. All of which is given as a sort of necessary preliminary, tending to prepare the mind of the reader for some most astounding figures regarding the future of copper. The following figures are not given as prophecies, but as possibilities, based mathematically on the ratio in which the consumption of copper has increased for the past century. To complete the computation for the nineteenth century I have added the 1898 product of 432,905 tons to the preceding table credited to Mr. Elwas, and have estimated the production of 1900 at only 450,000 long tons—a very conservative figure—bringing the world's copper production for the decennium ending with the year 1900 to the total of 3,619,905 tons. Based upon this estimate for the present decade, which is certainly none too high, the percentages of increase shown for the century by decennial periods, from 1810 (the first full period from which the computation can be made), is as follows:

Decade.		Production.	Per Cent Increase.
Ending	1810	91,000	..
"	1820	96,000	5
"	1830	136,000	41
"	1840	218,400	60
"	1850	281,000	28
"	1860	505,999	80
"	1870	900,000	77
"	1880	1,189,400	32
"	1890	2,215,900	86
"	1900	3,619,905	63

The average decennial increase in the copper production of the world has been 52 per cent, for the nineteenth century. For the last half of the century the increase has averaged 67 per cent. For the past thirty years it has averaged 60 per cent.

Following the trend of the figures of actual increase for the century now closing, I have prepared a set of tables for the twentieth century. I do not put these forth as a prediction—merely as the copper production of the twentieth century produced, according to three sets of figures deduced from the actual figures of the past hundred years. The first column gives the annual—not decennial—production for the last year of each decade named, according to the ratio of average increase of 60 per cent per decade for the last 30 years of the cen-

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tury; the second column gives the average annual production by decennial periods at the ratio of 50 per cent increase established by the average increase of 52 per cent per decade from 1810 to 1900, while the third column gives the figures at the rate of 25 per cent, which is 3 per cent less than the smallest decennial increase of any decade since 1820:

Decade	Average Annual Product at 60 Per Cent Increase.	Average Annual Product at 50 Per Cent Increase.	Average Annual Product at 25 Per Cent Increase.
Ending 1910	579,200	543,000	452,500
" 1920	926,720	814,500	565,625
" 1930	1,482,752	1,221,750	707,031
" 1940	2,372,403	1,832,625	883,788
" 1950	3,795,845	2,748,838	1,104,735
" 1960	6,073,352	4,123,407	1,380,918
" 1970	9,717,363	6,185,111	1,726,147
" 1980	15,547,781	9,277,666	2,157,683
" 1990	24,876,449	13,916,449	2,697,103
" 2000	39,802,319	20,874,673	3,371,378

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Given an output of almost 40,000,000 tons in the year 2000 and at the present value of copper the product would be worth the tidy sum of $13,267,439,000. By present standards of mining and financing, the market value of the "coppers" duly listed in that period would be about two hundred and fifty billions of dollars, and about eight million men would be required to mine, mill and smelt the annual output. Even at the rate of a 25 per cent increase every ten years, which is less than half the average increase for the same length of time in the nineteenth century, the appalling total of 3,371,378 tons annually is reached in the last year of the twentieth century.

The foregoing figures were not prepared as a curiosity, nor for the benefit of some crafty promoter of a future copper company, but as a sort of gentle hint to the "authorities" who are predicting an immense surplus of copper in the near future with prices at cost and the industry gone to the dogs generally. An unbiased consideration of the copper situation of the world as a whole will lead to the opinion of the writer, that the new copper mines now being so freely opened, in the United States and elsewhere, have been begun not a day too early, and that their aid will be required as soon as it can be given in supplying the world with the normal amount of copper required to meet legitimate demands at fair prices.

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Descriptive.

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Idle Mines, Dead Corporations

and

Duplicate Names of Active Mines.

It may be asked why I have included a number of dead mining companies in the following pages. To such a possible question I would answer that the frequent inquiries received in the past two years regarding mining companies long since dead have convinced me that the few pages required to list a considerable number of such defunct corporations will serve a useful purpose. It has been deemed best to divide the copper mines into two classes, one of which will include the idle or moribund properties and companies out of business, while the second will be devoted solely to the mines now active. The list of inactive mines and dead corporations is appended:

ETNA.

This was a Keweenaw county property, which produced a total of 70 tons 881 pounds of ingot copper, in the years between 1863 and 1873.

ADAMS.

This was one of the pioneer properties of the Portage Lake district and with the South Pewabic was merged into the present Atlantic mine, on the formation of the Atlantic company.

ADVENTURE.

The old Adventure mine has been merged in the Adventure Consolidated, and will be given consideration in the article devoted to the latter named property.

AGATE HARBOR.

This property is located about ten miles east of Eagle Harbor, and was never a producing mine, though prospected to some extent. Its existence was recalled to the memory of pioneers by litigation between two sets of alleged owners, early in 1900, one claimant being Rene Vion, of France, the other John H. Gatiss, of Eagle Harbor. M. Vion was the original owner, but title was secured by Gatiss through purchase at a sheriff's sale.

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AHMEEK.

The Ahmeek property consists of a tract of 920 acres on the mineral range, lying immediately west of the Mohawk. Two shafts were sunk, in the late seventies, to intercept the Kearsarge lode, but were abandoned at shallow depth, without success. The recent opening of the Mohawk mine has shown that the northern extension of the Kearsarge lode has a strike inclining more sharply eastward north of the Wolverine and Kearsarge than on those properties, explaining why the Ahmeek shafts did not reach the lode. The underlay of the Kearsarge is possessed by the Ahmeek, though at great depth, except in the southern end of the property. A profitable mine might be opened on the Kearsarge lode on the Ahmeek property, though such work would necessarily be quite expensive, as vertical shafts would be required to open the greater part of the territory. It is probable that the Kearsarge amygdaloid outcrops on the southeast corner of the Ahmeek lands, and room might be found there for a couple ef shafts on the incline of the lode. The southern 320 acres of the Ahmeek will eventually be valuable to either the Kearsarge branch of the Osceola Consolidated, or to the Mohawk, though both the mines last named have all the territory they can develop for some years to come.

ALBANY & BOSTON.

The Albany & Boston Mining Company was organized in 1860 and sold its property to the Peninsula company in 1882, after expending $840,000, mainly on the Allouez conglomerate lode, though some attention was paid to the Pewabic amygdaloid. The Peninsula company got to the end of its financial tether in 1892, and the property was sold in 1895 to the Franklin company, and is now known as the Franklin Junior.

ALBION.

The Albion company began mining in 1848 on Section 11, Town 58-32, adjoining the old North American mine, Keweenaw county. A shaft was sunk 315 feet through the greenstone and an adit was driven from the south, connecting with the shaft at a depth of 115 feet. The work was done on a fissure vein 30 inches wide, which proved barren of copper. The property became known later as the Manhattan.

In 1852 the company pulled up stakes in Keweenaw county and began operations in Houghton, on a property also known as the Albion, which later became the Columbian, then through consolidation with the Shelden became the present Shelden & Columbian. Very little work was done on the Albion in Houghton, and that not to advantage.

ALGOMAH.

A property known as the Algomah, consisting of 320 acres on Section 30-51-37, in the Bohemian district, Ontonagon county was worked from 1852 until 1854, with negative results.

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ALGONQUIN.

The Algonquin company was organized in 1848 and "gophered" for 10 years in two sections of land owned in Towns 51 and 52, Range 37, Ontonagon county, in the Bohemian district. The property became known later as the Pennsylvania.

ALLIANCE.

This company did some mining in the early fifties on the so-called South Range of Keweenaw county, without finding anything of much promise.

AMERICAN EXPLORING CO.

This corporation sunk a few pits in a narrow lode of epidote, on Amygdaloid Island, Isle Royale, previous to 1850, but found nothing of value or even of promise, and disappeared from sight.

AMERICAN MINING COMPANY.

This was a corporation organized at Windsor, Vermont, in 1849, and owned the Norwich, Derby, Windsor and Sharon mines, all lying west of the Ontonagon river. The company operated with good intentions and poor judgment, with the usual result.

AMYGDALOID.

This is one of the larger of the long-idle mines of the district. It has produced a total of 770 tons 180 pounds of refined copper, the first production having been made in 1862, and the last in 1874, although the mine was regularly worked for nine years only, from 1862 until 1870.

The Amygdaloid property consists of 2,240 acres of land of which 2,000 acres is situated in Sections 16, 21, 22, 28 and 33, in Town 58 North, Range 30 West, while a stampmill site of 240 acres is owned in 34-59-30, having a double frontage of one mile on Lake Bailey and three-quarters of a mile on Lake Superior. The property was owned by a Philadelphia corporation, and the copper secured from the mine amounted to nearly a half million dollars in value. Six shafts were sunk and seven levels opened. The property is at present owned by Mr. J. F. Carey of Escanaba and Mr. E. L. Wright of Hancock.

AMYGDALOID AND ISLE ROYALE.

This was a pioneer Lake Superior copper mining corporation of the latter forties. A shaft was sunk for a short distance on an amygdaloid bed two feet in width, just north of the Minong mine, Isle Royale. The directors reported their product for the first year, from the aforesaid shaft, as thirty pounds of refined copper. It is needless to say that the corporation paid no dividends.

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ARCADIAN.

The old Arcadian mine became the nucleus of the present amplified Arcadian, which includes a half dozen adjoining properties, and will be treated of under the heading of the present Arcadian, in the list of active mines.

ARCTIC.

An attempt was made in the spring of 1899 to organize a company under this name to take over the Belt mines. Messrs. F. M. Delano of Detroit and Hornblower & Weeks of Boston were looking after the financial end of the matter, and the property itself was held under option by Don M. Dickinson of Detroit, Peter White of Marquette, and others; but the investing public had begun to look askance at copper propositions by the time the "Arctic" was placed on the market, and the incorporation was abandoned, after a considerable part of the stock had been subscribed.

ATLANTIC (No. 1.)

This old company had no connection with the present Atlantic, but did a little work on the Southwest quarter of 34-51-38, Ontonagon county, in the early fifties, without finding anything of promise.

ATLAS.

At this old property, between the Phoenix and Cliff, some mining was done about fifty years ago, on a fissure vein. Some old buildings mark the scene of early activity. The property was sold to the Phoenix Consolidated in the spring of 1900.

AZTEC.

This property took its name from the ancient pits found on the surface of the lode, it being believed some fifty years ago, that the copper mining in prehistoric times had been done by the Aztecs. The mine consists of 160 acres, just east of the old Hilton which is now a part of the Adventure Consolidated. One mammoth mass, weighing about 100 tons, was found in the Aztec. A total of $150,000 was spent on the property, which produced 353 tons 863 pounds of refined copper.

BAY STATE.

This mine produced its first copper in 1865; and after producing 199 tons 1,115 pounds of ingot copper, was sold in 1868 to the Phoenix, of which it has since remained a part.

BELL.

A property on which a little exploratory work was done in early days. It lies south of Lake Fanny Hooe, in Keweenaw county.

BELT.

This is one of the more important of the idle mines, and one which is morally certain to see further mining work at some date, earlier or

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later. Capt. W. A. Dunn, of Houghton, is now negotiating for the acquisition of the Belt group for Philadelphia capitalists, the group including the Penn, Bohemian, International and Great Western mines. The Penn is generally considered the most promising of the group. The Belt mines have produced 333 tons 1772 pounds of refined copper. These mines afford a melancholy example of "how not to do it." Early in the eighties the properties composing the Belt were bought by an English company, which expended a great amount of money on surface improvements, only to find that the mines were unable to feed the mill. Had the money expended on surface been spent underground, and vice versa, the Belt would have had the chance to prove its actual worth—which chance unfortunately has never yet been given the property. The copper produced by the English corporation was made at an actual cost of very nearly ten thousand dollars per ton, or at the rate of five dollars per pound, at which figure the owners failed to realize a profit.

There is considerable machinery, in a fair state of preservation, at the mine. Much of this would be unavailable for modern mine and mill practice, but there would be considerable salvage, as the improvements include a mill with two Ball stamps, three hoists of considerable size, a good air compressor, mine pumps, locomotives, rock cars and dwellings. The plant is amply sufficient for use in exploring, and, if need be, developing the mine to a producing stage; but considerable additional sums would be required to fit the property for actual production, if the underground developments were found to warrant mining on a large scale. The mine is now in the hands of R. R. Goodell and others, of Houghton.

BLUFF.

This mine was opened in 1852, on a twelve-inch fissure in Section 15, Town 58, Range 29, Keweenaw county. Two shafts were sunk to the 30-fathom level, and about 600 feet of drifting done. Work was abandoned in 1855.

BOHEMIAN.

The Bohemian Mining Company was one of the first to operate in the Ontonagon district, having been organized in 1848. The Bohemian mine, previously known as the Piscatauqua, was bought in 1853 for $3,000. The company spent $181,985.90 in ten years, and produced copper worth $13,320.17. A reorganization was effected in 1863, but the mine was closed in 1866; reopened in 1870, and again closed in 1871. It is now a part of the Belt group.

BRITISH AMERICAN.

This company operated north of the greenstone, in Keweenaw county, in Sections 2 and 11, 58–30, doing some work in 1854–55 on a two-foot fissure vein, and again in 1880-81 on a fissure crossing the ashbed. It is now a part of the Chicago property.

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CALUMET BELT.

An 1800-acre tract between the Cliff and Central mines, in Keweenaw county, on which a little desultory digging was done.

CALUMET.

The original Calumet & Hecla, from which the Hecla was set off in 1867, to be reabsorbed in 1871, under the new name of Calumet & Hecla.

CALEDONIA.

A property on which assessments of $140,000 were expended, prior to its absorption by the Flint Steel in 1871.

CAMBRIAN.

Organized in 1854, owning 160 acres in 24-48-49, near the Montreal river, the boundary line between Michigan and Wisconsin. A little exploring was done, without finding anything of value.

CARP LAKE.

This property is located in the Porcupine Mountain district, consists of 1,087 acres in Town 51, Range 43, and is but one-half mile south of Lake Superior. The company was organized in 1858 by Cleveland men, who sunk two shafts and drove two adits into the high bluff existing at that point, one adit being 250 feet in length. Machinery was bought and delivered on the ground for a mill, but the company quit work in 1862, from lack of funds.

In 1897, when the premonitory symptoms of the approaching boom in copper first became apparent, the owners again turned their attention to the old property. Mr. John C. Jones, of Cleveland, superintended the resumption of work in September, 1897, but work was stopped in the following winter. In the summer of 1898 work was resumed under charge of Mr. H. L. Payne, of Cleveland, and again suspended in the following winter. In the summer of 1899 Mr. Geo. E. Perkins, of Providence, Rhode Island, was in charge of work at the property. In the early spring of 1900 Messrs. Warren and Payne were on the ground, and resumed work with a small crew of men. A dozen barrels of good copper bearing rock were secured and sent east for experimental purposes.

Like the other properties of the Porcupine Mountain district, the Carp Lake is opened on a conglomerate sandstone, and the copper is exceedingly fine, and found freely disseminated through the rock, estimates of the copper content ranging as high as 7 per cent. The metal is in the thinnest possible flakes, being akin to the "flour gold" which gives western miners so much trouble. The flakes are so minute that they float on water and it is the belief of the present owners that they cannot be saved by any ordinary process of milling. The lode is about seven feet in thickness—the same as at the Nonesuch—

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and very flat, dipping at an average of only 26 degrees. One shaft is down 350 feet. It has been proposed by the present owners to drive an adit southward into the hill, the contour of the country rendering such a project feasible. Such a tunnel would prove the territory traversed. The mine is credited with a production of 15 tons 1,135 pounds.

Alfred Meads, of Marquette, for many years a resident of Ontonagon, and than whom no man now living has a better knowledge of the history, geology and mines of Ontonagon county, assures me that in his opinion the Carp Lake copper is not too fine to save by the machinery now in general use. It is his belief that the same machinery, skill and care employed at the Atlantic and other active mines of this district producing fine copper, would make the Carp Lake a paying property. He states that the copper is very fine indeed, but not flake copper—that it is granular in form, and will not float, though easily carried away by a strong stream of water. Mr. Meads states that a mistake has been made in sending much of this rock to a mill, as some of it runs as high as 40 per cent copper, and should go direct to a smelter. In his opinion too much time has been spent on experimenting and the proposed adit is not advisable, as there are already five shafts opened on the lode.

CASCADE.

This mine is in the Norwich district, west of the Ontonagon River. Some "gophering" was done in 1853-54—not enough to afford any criterion as to the merits or demerits of the property.

CENTRAL.

It seems sad that this grand old property should be listed among the inactive mines. The mine was opened in 1854 and for nearly forty years was a steady dividend-payer, affording employment to a large number of men, and returning substantial profits to its owners. The mine was closed down in July, 1898, and the mill suspended work one month later. Since that time some exploring with the diamond drill has been done on the line between the Central and Eagle Harbor properties, at their joint expense, principally in hope of striking the Kearsarge amygdaloid lode.

The Central was opened on a fissure vein, and produced copper and silver marketed for $9,770,528.57. Of the gross receipts, only $2,479.42 was expended for lands, the balance being divided approximately into fifths, of which the shareholders received one part, in dividends of $1,970,000, and about four-fifths, amounting to $7,982,712.36 was expended for labor, machinery, improvements, freight and other running expenses. In the year 1899 the expenses were $10,926.49, of which $6,380.25 was spent for diamond drilling. Receipts were but $845.37, practically all from sale of cordwood, and the Central entered the year 1900 with a floating indebtedness of $3,214.39. The company's lands are extensive, and probably contain paying copper deposits, if such can only be located.

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CHICAGO.

Owns 520 acres of land in Sections 2 and 11, 58–30, Keweenaw county.

CHIPPEWA.

Owns 160 acres in 30–51–37, Ontonagon county, in the Bohemian district, on which a little exploratory work was done many years ago.

CLIFF.

This mine was a magnificently profitable property and the first dividend payer among Lake Superior mines. It has been practically idle since 1878, though a few tons were produced annually by tributors for some years after that date. Like the Central, of the same county of Keweenaw, the Cliff was opened on a fissure vein, the productive capacity of which eventually reached an end. The mine was opened and operated by the Pittsburgh & Boston Copper Company during the period of its prosperity, though always known as the Cliff.

CLIFF COPPER COMPANY.

This corporation bought the Cliff mine after it was practically exhausted, and took out but a small amount of copper.

CLIFTON.

This property comprises 320 acres two miles west of the Norwich, in the trans-Ontonagon district. It was opened in 1852 and closed in 1855, after sinking two shafts to depths of 123 and 263 feet respectively, and driving an adit 300 feet. Only a few tons of copper were secured.

CLINTON.

Next west of the Cascade, in the Norwich district, comprising 320 acres of land, opened in 1853 and abandoned after sinking a single shaft to a depth of 80 feet.

COLLINS.

Bought 1614 acres of the Ohio Trap Rock Company in the early fifties, and did a little puttering around, without results.

COLUMBIAN.

Successor of the Albion, at Houghton. Was united with the Shelden in 1864 to form the Shelden & Columbian.

CONCORD.

Set off by Pewabic in 1879. Produced 343 tons 857 pounds refined copper in all. Absorbed by the Arcadian in 1898.

CONGLOMERATE.

See Oneida.

CONKLIN.

Held under a permit from the war department, issued about 1846. Known later as the Merryweather, then Eureka.

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CONNECTICUT.

Opened on fissure south of the greenstone, on the west half of the southeast quarter of 16-58-30, Keweenaw county—same vein as worked by the Eagle Harbor. Stopped work in 1857, but tributors took out a few tons of copper for several successive years following. Now part of the Eagle Harbor.

COPPER FALLS.

One of the big mines of Keweenaw county. The Arnold was set off from the Copper Falls some years ago, and the offspring devoured the parent in 1898, by absorption. See Arnold, in list of active mines.

COPPER HARBOR.

South half of 10-58-28, Keweenaw county.

THE COPPER MINING COMPANY.

Organized in 1864 on 320 acres in 20 and 21-52-36, Bohemian district. Did a little exploratory work only.

CORTEZ.

Organized in 1852, and did a little gophering west of the Ontonagon River.

CUSHIN.

Opened in 1849—became the Forest a little later, and eventually the Victoria.

CUYAHOGA.

A company by this name was organized at Cleveland, Ohio, in 1860, and spent a few thousand dollars in explorations in the Porcupine Mountain district, at the time of the Nonesuch excitement. The wife of President McKinley owns lands in the immediate vicinity of the Cuyahoga.

DACOTAH.

An early organization on which very little exploratory work was ever done. Consists of the southeast quarter of Section 35, 55-34, fronting on Portage Lake and containing a trifle more than 160 acres. Lies immediately west of the village limits of Houghton.

DANA.

The east halves of Sections 24 and 25, 58-31. Bounded on the north by the Copper Falls portion of the Arnold, and surrounded on all other sides by the Central. Never a producer.

DELAWARE.

See Oneida.

DERBY.

One hundred and sixty acres lying four miles west of the Norwich, in Ontonagon county. Organized in the boom of 1852, and is on record with an official product of 1,200 pounds of copper. Such outputs would

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appear more imposing if expressed in troy ounces, like silver products. Sunk two shafts to depths of 60 and 80 feet and did 250 feet of drifting.

DEVON.

West of the Ontonagon; 320 acres set off from the Forest--now Victoria—in 1852. Only a little gophering done on the lands.

DODGE.

A few gopher holes only, in the sixties. Became part of the Miners early in 1899, and was absorbed with the latter by the Isle Royale Consolidated a few months later.

DORCHESTER.

Organized 1863. North of the Pontiac end of the Quincy. Did a little mining on the Mesnard epidote in the early sixties. Now part of the Arcadian.

DOUGLASS.

Organized 1863. Sunk four shallow shafts and produced 84 tons 1,502 pounds of copper. Shafts supposed to have been on the Isle Royale epidote, but probably were on the Grand Portage lode. Now part of the Arcadian, and is perhaps the most promising end of the amygdaloid workings of that mine.

DOUGLASS HOUGHTON.

Opened in 1853 on 15-51-37, in the Bohemian district. Had a mill with 8 gravity stamps run by water-power. Made about 30 tons of copper in all. Now the Henwood.

DOVER.

Consists of the northeast quarter of Section 3-55-33, just north of the Oneco.

EAGLE HARBOR.

A tract of nearly 7,000 acres of land occupying a large part of the western half of Town 58 North, Range 30 West, Keweenaw county. Bounded on the north by Lake Superior, on the east by the Amygdaloid, Native Copper and Conglomerate (Oneida); on the south by Canal lands and the Central; on the west by the Central and Arnold mines.

EAGLE RIVER.

One of the earliest-opened properties of Keweenaw county. Produced only 25 tons in all. Has 360 acres east of the Phoenix and south of the Humboldt and Natick.

EAST MOHAWK.

A company said to have been organized in 1899 to take over 1,280 acres adjoining the Mohawk—probably lands from the Bacon & Jacob tract in 23 and 26, 57-32.

EDWARDS.

Now part of the Arcadian.

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EMPIRE.

A tract of about 2,100 acres lying in Section 1, 2, 3, 10, 11, 12 and 14, 58-29, east and southeast of Mosquito Lake, Keweenaw county.

ESSEX (No. 1.)

Became the Norwich.

ESSEX (No. 2.)

Organized in 1864, on lands in 58-30, Keweenaw county, and did a little exploring south of the greenstone.

EUREKA.

A trans-Ontonagon property better known as the Merryweather. With the Plutus was used in foisting the "Wahnita" on the public in 1899.

EVERETT.

Better known as the Shawmut. One square mile in 52-36, between the Elm River and Wyandot mines.

EVERGREEN BLUFF.

South of Adventure and Mass mines. Organized in 1853 by Detroit men. Worked from 1854 until 1863 and produced 675 tons, 1174 pounds of refined copper, which sold for $86,582.24, and was produced at a cost of $223,582.24. Not an unpromising property, notwithstanding its bad financial record—which was no worse than that of a number of mines that have since proved profitable.

FARM.

The Farm was consolidated in 1855 with the Toltec, which thereupon became the Toltec Consolidated.

FIRE STEEL.

One hundred and sixty acres in the northwest quarter of 22-51-37, Ontonagon county. Opened 1852 and closed 1855. Machinery was sold to the Douglass Houghton (now Henwood) mine.

FITZGERALD.

A later name of the old Hungarian mine—now the Oneco.

FLINT STEEL.

The southwest quarter and west half of the southeast quarter of Section 12, also the southeast quarter of Section 11, 50-39. Was set off from the Minnesota in 1855. Levied and expended assessments of $204,000. In 1871 absorbed the Caledonia, which had expended $140,000 raised by assessments. After the amalgamation assessments amounting to $60,000 were levied and spent on the consolidated property. The Flint Steel produced 415 tons 458 pounds of refined copper.

FLINT STEEL RIVER.

Same as the Flint Steel.

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FLORIDA.

A mining company organized to mine on the north half of 25-56-33, a tract cornering diagonally on the southeast with the Calumet & Hecla. The mineral rights are now owned by the Calumet & Hecla. The Florida tract is too far east to carry the outcrop of the Kearsarge lode, but probably has the amygdaloid on which the Old Colony is working, also other lodes between the Kearsarge and the Eastern Sandstone.

FOREST.

An early incorporation operating west of the Ontonagon River. Set off a great number of small tracts on which independent mining companies were organized in the boom of the early fifties. Many of these tracts have since been reabsorbed. Expended $100,000 raised by assessing shareholders between 1850 and 1858. Reorganized in 1858 as the Victoria, and expended $80,000 more. Was reorganized, or rather made over, as the present Victoria company in 1898-99. Now working. See title "Victoria," in list of active mines.

FOREST SHEPPARD.

A tract of 2,366 acres on the shores of Lake Gogebic. Organized in 1864 and did a little exploratory work in 1865, and again in 1874. Nothing of promise found.

FORSYTH.

An early incorporation which did little work. The property became the Fulton, and in 1898 the Mohawk. See "Mohawk," in list of active mines.

FRENCH COPPER MINING COMPANY OF LAKE SUPERIOR.

Organized in Paris in 1858. Dissolved in 1860 as insolvent. Owned the Agate Harbor, Bell, Clark and Montreal properties, in Keweenaw county. Was bought by Edouard A. J. Estivant, of Paris, who still owns the Clark mine.

FRUE.

A property next south of the Huron, in Houghton, on which a little exploring was done in the sixties and seventies. With the Dodge and adjacent mineral lands was incorporated in the Miners Copper Company, early in 1899.

FULTON.

Became Mohawk, in 1898. See "Mohawk" in list of active mines.

GARDEN CITY.

An early mine in Keweenaw county, which produced 37 tons 1397 pounds copper. Now part of Phoenix Consolidated, which see, in list of active mines.

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GLENN.

Set off from the Forest in 1852. Consisted of 240 acres in 31-50-39. Absorbed later by its parent, which meantime had changed its name to Victoria.

GLOBE.

A tract of 3,200 acres, consisting of Sections 1, 2, 3, 4 and 5, in Town 53, Range 35. Is located next south of the Copper Range-Canal Company lands and is owned by John Stanton. Property is likely to prove valuable, as it crosses the entire width of the mineral range, from Eastern to Western Sandstone, and the developments of the past two years at the Baltic, Trimountain and Champion mines indicate the possibility of the great Baltic amygdaloid lode crossing the Globe property. In the seventies a little exploring was done by Dr. Brunschweiler, of Calumet, near Eleven Mile Creek, but owing to the difficulty of hauling in supplies the work was dropped. Copper was found by Captain John Wedge at Thirteen Mile Creek, in the same year that Captain John Ryan opened what has since become the Baltic, at Six Mile Hill.

GOGEBIC MINING COMPANY.

Organized in 1853 on the southwest quarter of 26-44-42, near Lake Gogebic, and spent something less than $10,000 on exploratory work without decided results.

GRAND PORTAGE.

A pioneer mine of the Portage Lake district. Located just south of Houghton. Organized in 1852, reorganized in 1860, sold in 1879 and organized anew in 1880. Sold in 1897 to the Isle Royale Consolidated, of which it is now a part, being the northernmost end of that property. Produced a total of 1,613 tons 434 pounds of refined copper, 1852 to 1883.

GREAT WESTERN.

A property in the Bohemian district, set off by the Pittsburg & Boston Company in 1863. Became a part of the Belt.

HALLIWELL.

The Halliwell Copper Company was organized at Cleveland, in 1895. It owns 880 acres of land in Sections 27 and 28, 51-42, in the Porcupine Mountain district, which possesses a special fascination for Cleveland people, who have furnished most of the money spent in that section. A little exploring work was done in 1896, and a very complete little plant of machinery was put in, including a portable sawmill. Various copper-bearing strata have been uncovered, these being known to the management of the mine as the Black Amygdaloid, Quartz, River Bank, Noble, Mass and Butler lodes. The identity of the two

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latter with the lodes of the same name existing on the Mass and Adventure properties many miles to the eastward is open to doubt. The first work in 1896 at the Halliwell was done under the superintendence of A. A. Atwater, and later work has been in charge of H. H. Reeves. The Noble lode seems the most promising, judging from present developments. A number of shafts have been sunk, some of which are mere test pits, but two of which are between 100 and 200 feet in depth each. The lode called the "Mass" also shows fairly in copper. The company is organized under the laws of West Virginia, with a capital of 100,000 shares, par value $5 each.

The Halliwell is located only two miles from Union Bay, on Lake Superior, and could readily tram its rock from the mine to a mill built on the bay—which is a fair harbor and could be improved at small cost—by a gravity line, doing away with the necessity for a railroad.

An attempt was made in the winter of 1899-1900 to secure additional capital from the shareholders, who were offered 15,000 shares at $1 per share. An attempt was also made a little later to interest Boston capital in the property, but Boston people are loaded with "coppers," and are not taking on any further cargo of that sort at present, though they will buy readily enough if prices go higher. This seems to be a characteristic of investors and speculators generally, its manifestation not being confined to Boston alone.

A little exploring with a diamond drill has been done during the season of 1900 on the Halliwell property.

Cleveland people have made millions out of iron mines, and have sunk at least a million in Lake Superior copper mining. Some fair-sized blocks of dividend-paying copper shares are owned by individuals in Cleveland, but every lake copper company organized or financed in that city has come to grief. Cleveland men have dabbled in Lake copper mining for fifty years, and apparently know just as little about the business now as half a century ago.

The Halliwell is a promising property. It is handicapped by its location in a district where only failures have been scored, but the actual showing of copper is sufficient to warrant the expenditure of the money to develop the property to a point where it will be enabled to actually demonstrate its value or worthlessness. It is folly, however, to dribble money into a Lake Superior copper mine; the cash might as well be thrown into the lake itself. Ten thousand dollars at a time will never develop a Lake copper mine to the dividend-paying point. Fifty thousand dollars judiciously expended on the Halliwell would bring the property to a point where a much better opinion could be formed of its value. Indications are that such a sum carefully spent would afford a very fine showing. A quarter to half a million dollars would make a producing mine of the property, and appearances now are that the mine, adequately opened and equipped, would prove profitable.

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HANCOCK.

The Hancock Mining Company was organized in 1859, to work the lode next west of the Pewabic amygdaloid. The property is in the western end of the village of Hancock, and its surface is now pretty well built over by that thriving town. The tract consists of 160 acres, being the southwest quarter of 26–55–34. In addition to the shaft, an adit was driven from the south, at a height of 218 feet above the mean water level of Portage Lake. The company expended $248,395, raised from assessments, and in 1873 was reorganized as the Sumner Mining Company. But little work was done by that company, and in 1880 the property was sold to Edward Ryan, of Hancock, who changed the name back to the original one, and organized the Hancock Copper Mining Company in the same year. The property was worked for five years and closed down in 1885. The lode is narrow, but fairly rich. The property might be worked at a profit if opened well ahead and equipped with the best machinery and a modern mill. The old mill on the lake shore frontage of the property has been sacrificed to the march of improvement, in common with its neighboring mills of the Osceola, Quincy, Pewabic and Franklin, on the Hancock side of Portage Lake, and the Atlantic, Isle Royale, Shelden & Columbian and Grand Portage mills on the Houghton shore. The total production of the Hancock mine was 2,584 tons 1,384 pounds of refined copper.

HANOVER.

Organized in 1860 on the west half of 8–58–28, Keweenaw County. Opened two fissure veins, spent $20,000, and quit.

HARTFORD.

Had 320 acres in Sections 32 and 33, 50–40, two miles west of the Victoria. Organized in 1864 and produced three tons of copper.

HAZARD.

A property of the early sixties, now part of the Mass Consolidated.

HECLA.

Set off from the Calumet, and reincorporated therewith in 1871, under the present title of Calumet & Hecla.

HENWOOD.

Formerly Douglass Houghton. See that title, preceding.

HIGHLAND.

Organized in 1863. A little mining was done on the property in that and the two following years by the Franklin and Pewabic companies. Produced a total of 333 tons 8 pounds of refined copper. Mineral rights and most of the surface now owned by the Arcadian.

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HILTON.

Formerly the Ohio. Now part of the Adventure Consolidated. Produced a total of 21 tons 1819 lbs. of copper.

HOME.

A 240-acre tract adjoining the Humboldt, in Keweenaw County. Organized in 1863. Did very little work and produced no copper.

HOPE.

Organized in 1864, adjoining the Humboldt Mine, in Keweenaw County. A little exploring only, without decided results.

HUDSON.

West of the Ontonagon River, in the Norwich district. Organized in early fifties, suspended work in 1856. Opened two shafts, on two different veins, to depths of 60 and 75 feet.

HUNGARIAN.

Became Fitzgerald, then Oneco. See Oneco in list of active mines.

INDIANA.

Has 1,280 acres—two square miles—in Sections 21, 27 and 28, Town 51, Range 37, Ontonagon County, next south of the Henwood Mine. The company was organized in 1862 and worked steadily for three years, spending $200,000 on the property, at the end of which time all work was stopped and movable assets sold to settle floating indebtedness. A stamp mill, of fair size and good design for those days, was one of the assets so disposed of. Two shafts were sunk, to a depth of 180 feet each, and connected on two or three levels.

INTERNATIONAL.

Originally Piscataqua, became International, then Bohemian, now part of Belt. See Bohemian.

IRON CITY.

Began mining in 1853 on 14–58–29, in the Mosquito Lake District, Keweenaw County. Sunk two shafts 300 feet apart, connected by two levels, one shaft 300 feet deep. Vein was wide, but barren. Also sunk some shallow shafts on a narrow fissure vein in 11-58-29, just to the north of the original workings.

IROQUOIS.

Organized in 1890; mainly as an offshoot of St. Mary's Canal Mineral Land Company. Comprised 160 acres, the southwest quarter of 7-56-32, just south of the Wolverine. Was bought in 1898 by the Osceola and is being opened by that company under the name of the South Kearsarge. See Osceola in list of active mines.

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ISLAND.

The Island Copper Mining Company was organized in 1873, and operated on Isle Royale, opening three shafts, 350 feet apart, on a 15-inch conglomerate reef. The shafts were sunk to depths of 50, 150 and 200 feet respectively, the two deeper shafts being connected on the first and second levels. The shafts are very flat, dipping at 19 to 25 degrees. A stampmill was built in 1875, and burned in 1876.

ISLAND TRIBUTE COMPANY.

Following the burning of the stampmill of the Island Mine in 1876 the property was leased to the Island Tribute Company, which worked the mine two seasons. The Island is credited with a total output of 60 tons 207 pounds of copper.

ISLE ROYALE.

The company was originally organized as the Ohio & Isle Royale, to mine on Isle Royale, but soon became disgusted and transferred its attention to the mainland, where a mine was opened on the hill just south of Houghton, in the Portage Lake District. Is now a part of the Isle Royale Consolidated, under which title, in the list of active mines, further particulars will be found.

ISLE ROYALE LAND CORPORATION.

This is an English concern, which succeeded to the holdings of the North American Mineral Land Company on Isle Royale. The latter company secured large tracts of mineral lands on the island, at nominal figures in most instances, buying during the long periods of depression that have alternated with brief epochs of activity on Isle Royale. The North American company gradually acquired title to most of the land north of the conglomerate sandstone that occupies the southern half of the island west of Siskowit Bay. In the latter eighties the holdings of the North American company were transferred to the Isle Royale Land Corporation, which also secured several tracts not owned by the former company. The present holdings aggregate 84,000 acres—more than 130 square miles—and include upwards of two-thirds of the surface of the island, taking in practically everything that possesses any prospective mineral value. Some exploratory work was begun in 1889, under the direction of Mr. S. S. Robinson. See Wendigo, which was organized by this corporation.

JEFFS LAND COMPANY.

This is a corporation owning about 800 acres in Sections 7, 8, 9 and 10, Town 50, Range 39, north and west of the village of Rockland, Ontonagon County. Exploratory work was done on the east half of the

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southwest quarter of section 9, during the summers of 1899 and 1900, with encouraging results. The land is so located that no small trouble has been experienced from the heavy rains of both years, these seasons having been the wettest ever known in the district. A conglomerate and two amygdaloid lodes were uncovered, one of the latter being quite rich in copper.

KAUKAUNA.

It was proposed, in the spring of 1899, to organize a mining company to be called the Kaukauna, on the old Shawmut and Stonington properties. The plan failed, through the public losing interest in new copper mining ventures at about the time the Kaukauna was ready for launching.

KEARSARGE.

Became part of the Osceola Consolidated in 1897, and is treated of under the name of the latter mine, in the portion of this book devoted to active copper properties.

KEWEENAW.

Became Meteor. Now part of Mendota. See Mendota.

KNOWLTON.

One of the pioneer mines of the Adventure District. Produced 323 tons 1,993 pounds of refined copper. Now a part of the Adventure Consolidated, under which heading further reference to the property will be found.

LAC LA BELLE.

See Oneida.

LAKE SUPERIOR (No. 1).

The Lake Superior Mining Company was one of the very first to engage in active work in the Michigan copper district. The company was organized in 1843, and begun work in 1844 in Keweenaw County, under a permit from the war department, full title being secured a little later. The Lake Superior became the Phoenix a few years after.

LAKE SUPERIOR (No. 2).

This property, consisting of 650 acres in Sections 13 and 14, 50–39, was sold to the Michigan company for $10,500, in 1899. It carries northeasterly continuations of the Evergreen and other lodes known to exist on the Michigan property. See Superior.

LAURIUM

This is an old company, which never did mining or exploring work of any importance, but the lands of which have become valuable

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through the building up of the great mining camp of Calumet. The property lies east of the Calumet & Hecla and Osceola mines, and the village of Larium, with an estimated population of 10,000, stands on ground sold by this company.

LONE ROCK.

A property in the Porcupine Mountain District owned by a corporation organized in Cleveland. A small amount of exploratory work was done in 1859-60, without uncovering anything of value.

MADISON.

The Madison Mining Company was organized in 1853, and owned about 2,000 acres of land in 58-30, Keweenaw County. It was the successor of the Summit, which was one of the first mines opened in the state. A limited amount of work was done in the fifties, on two fissure veins, known locally as the east and west, ten tons of copper being produced in 1856 and 1857. Attention was again given the property in 1865-66, when 24 tons 881 pounds of copper were secured. Again in 1880-81 a little work was done, less than two tons of metal being obtained. The property was bought in the middle eighties by the Central, of which it now forms the eastern portion.

MANDAN.

A tract of something less than 500 acres—520 acres less a small lake—lying just east of the Resolute, in Keweenaw County. Never a producer. A twin of the Medora, which lies next east.

MANHATTAN.

Company organized in 1856 and took over the old Albion property in 58-32, Keweenaw County. Sunk a shaft 70 feet, near the greenstone, and secured five tons of copper from a fissure. Stopped work in 1857, resumed in 1862 and stopped permanently in 1865. Property became a portion of the Cliff Mine later.

MARYLAND.

Set off in 1863 from the old Northwest. Lapsed to original owner, which meantime had become the Delaware Company. Now a portion of the Oneida.

MASS.

Became the nucleus of the present Mass Consolidated, under which title detailed reference to the mine will be found.

MATTAPAN.

Proposed name for an amalgamation of the Dodge, Frue and adjoining lands, which became the Miners, under another management.

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MEDORA.

A tract of 560 acres, one half mile wide and one and three-fourths miles long, just east of the Mandan, in Sections 8, 17 and 20, 58-29, Keweenaw county. Never a producer. Twin of the Mandan, lying next west.

MENDOTA.

The history of this mine is very much mixed with that of the Delaware, and to some extent with that of the Clark. These three mines had a score or more names, collectively, at different periods, and as names, owners and boundaries were frequently shifted it is now difficult to determine which was which, at various times in the past. At present the Mendota begins next east of the Delaware (Oneida), and lies mainly to the north of Lac La Belle, though with a fringe all along the southern border of that sheet of water, and running as far southwest as Deer Lake; while to the eastward there is nearly three miles frontage on Bete Gris Bay, Lake Superior. The Mandan and Medora lie to the north. There are nearly 11,000 acres in all comprised in the Mendota estate, which is owned by capitalists of Detroit and New York. The property was first known as the Keweenaw, then as the Meteor, next as the Lac La Belle, after which a portion became attached to the Northwest-Delaware-Conglomerate property and another portion became known as the Mendota. Mining was begun in 1855, and continued in a desultory fashion, as funds were supplied, until 1873, the practice being to work a season or two and lie idle for three or four.

Six shafts have been sunk on the property, one being 230 feet deep, three others about 100 feet each, and two which are little more than test-pits. No less than five bodies of copper rock and copper ore were prospected to some extent, and an amygdaloid lode carrying copper was found, but never opened. An adit was driven 1,000 feet into Bohemian Mountain, and another adit was driven nearly 400 feet into the hill, on an 18-inch vein of gray sulphide (not sulphuret, as usually stated) of copper. This ore body, being unusually free from antimony and arsenic, two metals usually found in close connection with sulphur ores of copper, is amenable to smelting much more readily than most western ores. There are other veins of ore on the property, and it is highly probable that a serious attempt will be made, sooner or later, to open a paying mine of copper ore. It is unlikely that the Mendota ore bodies are mere gash veins, such as those occurring in the Huron Mountains, in Baraga and Marquette counties, and there is reasonable promise of their holding their own to considerable depth, though a fissure vein can never compare with either an amygdaloid or conglomerate bed in the Keweenaw formation, for prospects of permanency in length and depth.

The Mendota-Lac La Belle companies built a ship canal connecting Bete Gris Bay with Lac La Belle, in 1866 and the year following, receiving therefor a grant of 100,000 acres of land in Schoolcraft County,

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upper peninsula of Michigan. The canal has been allowed to fall into a shocking state of decay, but could be dredged out at small cost. A harbor of refuge on Keweenaw Point would be a blessing to the marine interests of the great lakes, but the old 12-foot canal between Bete Gris Bay and Lac La Belle could be utilized by but few of the modern vessels, which draw 14 to 20 feet of water, as a rule.

One small shipment of Mendota ore was made to a furnace at Swansea some thirty years ago, and surprised the smelter by the ease with which it was reduced. Arrangements had been partially made to build a small smelter on the company's lands when the panic of 1873 happened along, since which time the owners have contented themselves with paying taxes.

MERCHANTS.

An old mining location of fifty years ago, on which no particular work was done, absorbed by the Adventure in 1858.

MERRIMAC.

A property located and explored nearly fifty years ago, but never developed. Became a part of the Mass Consolidated in 1898–99.

MERRYWEATHER.

Became the Eureka in 1863. See Eureka.

MESNARD.

Great excitement was caused in the Portage Lake District early in 1862, by the discovery of a mass of native copper weighing 18 tons, on the hill north of the Franklin Mine. A company known as the Mesnard was immediately organized to work the lands, comprising 160 acres next north of the Franklin location. The mass of copper was raised on skids, having been taken out of its bed and moved for a distance of nearly 50 feet by the prehistoric miners. It came from the lode known as the Mesnard epidote, to which both the Arcadian and Franklin companies are now devoting some attention. The Mesnard produced only 42 tons 97 pounds, and was sold for a small sum to the Quincy company in 1897. For present developments on the Mesnard property, see Quincy, in list of active mines.

METALLINE.

Owns 160 acres just south of the Tecumseh.

METEOR.

Formerly Keweenaw. Became Mendota. See Mendota.

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MICHIGAN (No. 1).

No connection with the present Michigan mine, which consists of the old Minnesota and several adjoining properties and is treated of in the list of active mines. Was located on 19–56–32, and was absorbed by the St. Louis, which in turn was bought a few years ago by the Calumet & Hecla.

MIDDLESEX.

Organized in 1864 on 800 acres of land in 58–30, Keweenaw County. No mining ever done.

MILTON.

Organized in 1864, on 880 acres of land in 50–40; 49–41 and 51–40, in the trans-Ontonagon District, a few miles from the Norwich. Was bought at receiver's sale in April, 1900, by Byron N. White, of Spokane, Washington.

MINERS.

Organized in winter of 1898-99, absorbing the Frue and Dodge "mines," south of the Huron. The Miners' was absorbed by the Isle Royale Consolidated in the early summer of 1899, the latter corporation being reorganized under the laws of New Jersey, with increased capital stock, in order to provide for the consolidation.

MINONG.

Company was organized in 1874, taking the Chippewa name of Isle Royale, on which island the property was located, and which the early French explorers named in honor of the puissant Louis XIV. The company had 1,445 acres, located on Sections 22, 26, 27, 34 and 35, in Town 66, Range 35.

This is much the most important and promising mine ever opened on Isle Royale, and one of the very few which yielded copper in any important quantity, or gave anything like a decent percentage from the stamp rock milled. A number of masses of considerable size were found from time to time, the largest being one of six tons, uncovered in 1878. The company sunk several shafts, the deepest of which was put down only 300 feet. A mill with one Ball head was built in 1876, in which year 1,579½ tons of rock were milled, yielding 20½ tons of mineral, which returned about 75 per cent ingot copper in the smelter, giving an average return of about 1 per cent ingot from the rock stamped.

In 1879, after five years' existence, the company found itself in financial straits, and was reorganized in order to secure additional capital. Work was stopped by the company in 1881, but tributors worked two seasons longer, doing fairly well. Since the fall of 1883 no work has been done on the Minong. The property is credited with a production of 249 tons 650 pounds of ingot copper.

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MONTEZUMA.

An early company owning about 200 acres next west of the Grand Portage, in Houghton. Very little work ever done. Surface is owned by the Shelden-Douglass Estate, of Houghton, except a considerable number of building lots sold to various purchasers, the Montezuma surface now being known as West Houghton. Mineral rights owned by the Shelden-Douglass Estate and under option to the Isle Royale Consolidated. The Montezuma underlay carries the continuation of the Isle Royale and Grand Portage lodes, as well as various other unnamed lodes containing copper.

MONTREAL.

A pioneer property located in Sections 8, 9 and 17, 58-28, Keweenaw County, and carrying a continuation of the fissure vein of black oxide of copper found on the Copper Harbor and Lac La Belle properties. Now a part of the Clark mine.

MUSCOWAUBIC.

Organized in 1859 on a tract of 1,000 acres in 51-43, adjoining the Carp Lake mine, Porcupine Mountains. A very limited amount of exploring work was done just preceding the Civil War.

NATICK.

Two hundred acres of mineral land between the Humboldt and Eagle River properties.

NATIONAL.

Next to the Minnesota the most important mine of Ontonagon County, and one of the three copper mines in that county that have paid dividends. Disbursed profits of $320,000 to shareholders in nine dividends paid in the years 1861 to 1872 inclusive. Idle since 1893. Has produced nearly 6,000 tons of copper all told.

The National company was organized in 1848. The company did some exploring on various lands owned in Ontonagon County, but met with no success until 1852, when title was gained to nearly all of Section 16-50-39, including a portion of the present townsite of the village of Rockland. The National people secured these lands from the state, and the Minnesota company also claimed title to a strip of this land, aggregating 115 acres, under patent from the United States government. A long and costly litigation followed, the National company winning. The National mine was opened on the westerly continuation of the contact vein on which the Minnesota was developed, and it was from this contact vein that both mines paid their dividends. The first copper from the National was taken in masses from a conglomerate lode, which also yielded some copper to the Minnesota company. The palmy days of the National were from 1860 until 1872. After 1872 the mine was let on tribute for eight years, with the usual result of

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good profits to the tributors and a badly used-up mine after they had finished their work. A tributor is a wrecker. It is his business to get the most copper at the least expense, and in the nature of things he cares nothing for the welfare of the mine beyond his own immediate requirements. Capt. W. E. Parnall, now at the head of the Tamarack, Osceola and Isle Royale mines, was made agent of the National in 1880, and did good work there, but it was beyond even his power to work miracles, and the mine was not brought back into the dividend-paying class. Work was suspended entirely in 1893, and the mine has since been idle. A hole was broken through between the National and Minnesota mines, between the 60 and 70-fathom levels, many years ago, but after the suspension of work at the latter mine a dam was built to keep out the Minnesota water. This dam will now save the Michigan people the necessity of unwatering the upper levels of the National at the same time as the old Minnesota is unwatered.

NATIVE COPPER.

Consists of 480 acres in Sections 3 and 10, 58-30, just north of the Oneida. Work was done in 1852-55 on a fissure vein. The company's capital was limited, its faith little, and the results of its work of a negative nature.

NAUMKEAG.

A tract of 400 acres in 3-54-34, west of the Isle Royale Consolidated and northeast of the Atlantic, the continuation of the Atlantic mineral body being assured the Naumkeag. A shaft of 112 feet was sunk on the property by the late Capt. Wm. B. Frue, about 30 years ago.

NEBRASKA.

Became Caledonia. See the latter.

NEW ENGLAND.

A tract of nearly 500 acres on the southern shore of Keweenaw Point, about two miles west of the extreme tip.

NEW JERSEY.

Set off in 1863 by the Northwest Copper Company. Consists of a parallelogram of 720 acres, cut in a most peculiar fashion, through the middle of the forties on both the east and west sides, in Sections 11, 12, 13 and 14, in 58-30, Keweenaw County. Never worked to any great extent.

NEW YORK.

A tract of 720 acres in Sections 3, 10 and 15, 57-32, Keweenaw County, just east of the Manhattan.

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NONESUCH.

The pioneer and principal mine of the Porcupine Mountain district, containing the treasures of Crœsus in copper, on the extraction of which fortunes have been lavished unsuccessfully, and which has been given the attention and best efforts of scores of mining men, metallurgists and chemists for the past generation; the Sphinx of the copper district—immovable, inscrutable and eternally tantalizing. The Nonesuch consists of a tract of one square mile at the southeastern end of the Porcupine Mountain copper range, being the south half of Section 1 and the north half of Section 12, Town 50 North, Range 43 West. Discovered in 1865, the mine was first opened in 1867, since which time it has swallowed several large fortunes, and has yielded the insignificant amount of 180 tons 1,072 pounds of refined copper from one of the richest lodes of copper-bearing rock ever opened.

The lode is an argillaceous conglomerate-sandstone, and was first discovered outcropping in the bed of the Little Iron River. A company for the exploitation of the property was formed in Ontonagon, in 1867, exclusively of local men, and work begun at once on the extraction of the anticipated fortune. The Calumet lode was then first giving unmistakable signs of the golden stream of profits which has since flowed in ever increasing volume from its many shafts, and the Nonesuch conglomerate assayed even richer than the Calumet conglomerate, though averaging only 78 feet in width, or about half that of the Calumet lode.

The strike of the Nonesuch conglomerate is 50 degrees north of east and its dip southeast—owing to its being located in the upper or sedimentary division of the Keweenawan trap formation. The foot wall is of conglomerate sandstone also, but of appreciably different texture, and the hanging is a bluish slate, foot, lode and hanging all showing somewhat similar characteristics, in gradations, and all carrying copper.

The Ontonagon company sunk two shafts to a depth of 180 feet each, at a distance of about 250 feet apart, on the dip of the lode. A small mill with Cornish stamps was built and run by water power, but the expected profits slipped through the mill, the copper being so fine that it was washed away with the sand. The experiment of smelting selected rock without previous dressing was tried, with encouraging results in a little furnace at Ontonagon, and without success in a big smelter at Detroit.

Up to the beginning of 1873 assessments of $40,000 had been levied and expended by the company, still composed of Ontonagon men. In that year some Cleveland parties were taken into the company to furnish needed capital, and from all accounts the new-comers lost no time in "freezing out" the original owners, by means of an assessment of one dollar per share. The property became insolvent in a few months, and was bid in by J. H. Wade, of Cleveland, in 1874. He began energetic work on the mine, deepening both old shafts and start-

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ing two new ones, but died in 1875. Shortly after his death the mill burned, and all work at the mine was stopped.

The Nonesuch was reopened in 1879 by Capt. Thos. Hooper, an experienced miner, who took the property on his own account and managed to make it pay, for the first and last time in its history. He built a mill with 16 gravity stamps, and by rejecting about one-third of the rock broken underground, continued to save 3 per cent mineral from the two-thirds of the rock product treated in the mill, equal to a little better than 2 per cent ingot—an average better than is now being obtained by any Lake Superior copper mine, with the exception of the Calumet & Hecla. Taking into consideration the fine copper lost in the tailings, it seems probable that the Nonesuch is the equal of the Calumet & Hecla in mineral contents. The lode carries no masses, and but a small quantity of barrel copper, which is found mainly as flakes, in the seams between the lode and walls.

On the strength of Capt. Hooper's successful work at the mine, the property was sold in 1881, the purchasers also buying his lease, which had several years to run. He was retained in charge, but his cautious plan of development was abandoned by the new owners, who wanted dividends immediately. A cargo of Nonesuch rock was shipped to the Portage Lake smelter for treatment without milling, and another small shipment went to Chicago for treatment by a patent chemical process. This latter proved a huge success, in the estimation of the inventor, and a large and expensive plant constructed on his plans was installed at the mine. A new mill, 67 x 130 feet in size was built, also new shops, engine house, dwellings, etc. In the mill a complete plant was installed, comprising three steam stamps, vanners, trains of Cornish rolls, slimetables and washers. After being stamped, crushed in rolls, jigged and passed over the slime-tables, the resultant product, something between fine sand and a coarse slime, went to drying pans, thence to a calcining furnace, and finally to precipitating tanks where the metal was allowed to settle, and then collected by a sort of crude electrolytic process.

On paper the process was a beautiful one; in actual practice it was a flat failure. The company lost much money and quit in disgust. About $400,000 has been sunk on the property by its different owners.

The property has been examined on an average once a year for the past quarter century, by parties having patent or secret processes for saving fine copper. Hundreds of tons of rock from the lode have been shipped to all points of the compass, for experimental purposes. The problem of saving the fine copper has been attacked mechanically, metallurgically, electrolytically, chemically, courageously and outrageously, by many different inventors—all of whom have suffered discomfiture.

The copper is there—millions and millions of pounds of it, every pound worth nearly 17 cents, when extracted, and not worth a penny a ton in the mine. Some day the problem will be solved, and a new crop of millionaires will be made by the Nonesuch.

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NORTH AMERICAN.

Opened two fissure veins on a 2,300-acre tract adjoining the Cliff. Sold the property to the Cliff for $100,100 in 1860. The purchasers invested in a gold brick.

NORTH AMERICAN MINERAL LAND COMPANY.

See Isle Royale Land Corporation.

NORTH CLIFF.

Consists of a tract of 1,026 acres, north of the greenstone, in Keweenaw County, set aside by the Cliff in 1858. Has the northern extension of the fissure from which the Cliff earned its dividends; also the ashbed lode of the Arnold. Mining work was done in the years 1858 to 1860 inclusive, when an adit of 1,700 feet was driven and three shafts sunk on the fissure, the deepest shaft being down 340 feet. An attempt to reorganize the company and float the property with adequate working capital was made in the spring of 1899, but did not meet with success.

NORTHWEST.

Became the Pennsylvania. See Pennsylvania.

NORTHWESTERN.

A Keweenaw County property of early days, absorbed by the Central at a nominal price. Produced not quite 200 tons of copper.

NORWICH.

The most important mine west of the Ontonagon River, although present developments at the Victoria indicate that this statement may not hold true very much longer. Has produced 500 tons of copper, which is nearly as much as has been made by all of the other trans-Ontonagon mines combined, including those of the Porcupine Mountain district.

The Norwich was organized in 1850, and built an eight-stamp mill in 1856. Work was stopped by the company in 1858, but the mine was let on tribute until 1863, when the Windsor mine was absorbed and additional capital secured by a reorganization. The mine shut down in 1865, after expending assessments aggregating $230,000. Some work has been done there in 1899 and 1900, but operations were suspended in the fall of the latter year. The mine has produced masses of as much as ten tons weight, and makes a good showing of stamp rock. At the present time it is impossible to interest capital in amount adequate to give the property a fair test. Small sums of money may suffice to make a fair showing, but it takes money by the hundreds of thousands to open a profitable producer. The Norwich is in the hands of Alfred Meads, of Marquette.

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OGIMA.

Made 491 tons 308 pounds of copper in the years 1862 to 1887. Now part of the Mass Consolidated.

OHIO.

Became the Hilton. See Hilton.

OHIO TRAP ROCK.

Opened in 1845 under permit of War Department on a tract of 1,702 acres in the Norwich district, Ontonagon county. Made 19 tons 685 pounds of copper in 1858 and stopped work that year. Had a 24-stamp mill and spent $150,000.

OHIO & DEAD RIVER.

The Ohio & Dead River Mining Company was the first concern to do mining work on Isle Royale, and one of the first engaging in the exploitation of the Lake Superior Copper District. Work was begun as early as 1844, under a permit from the War Department. The ignorance of actual mining conditions exhibited by the management of this corporation was scarcely greater than that of other concerns engaged in like labors at the same early day. The Ohio & Dead River company opened shafts on three different veins of prehnite and feldspar, each carrying copper, and each about an inch thick. The veins would scarcely have paid for working had they carried as much gold as they actually did contain copper.

OHIO & ISLE ROYALE.

This corporation begun mining as early as 1845 or 1846, and was the progenitor of the present Isle Royale Consolidated. The company's mining location on Isle Royale was next southwest of the Siskowit, on 23-66-34. Some mining work was also done on 27-66-34, where the city of "Ransom" was platted by Leander Ransom, in 1846. A small smelter was built at Ransom in 1849, but never went into blast. The late Columbus C. Douglass was agent of the property. The town of Ransom has long since disappeared, not only from the maps, but from the earth as well, a few remnants of crumbling foundation walls alone remaining to mark the site of what was once among the most populous and promising of Lake Superior mining camps.

ONEIDA (No. 1.)

The south half of 19-50-39, west of the Ontonagon River and south of the West Minnesota. Explored unsuccessfully in 1854 for the western continuation of the Minnesota contact vein. Became part of the Victoria.

ONEIDA (No. 2.)

Although this property is idle, it is not among the dead mines or moribund corporations. The Oneida Copper Company, which owns

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the lands hereinafter described, was incorporated in November, 1899, under the laws of Maine, with a capitalization of $2,500,000, there being 100,000 shares of the par value of $25 each. Chas. H. Palmer, of Boston, who was in charge of the property when it was last worked, nearly twenty years ago, is president of the Oneida company. The Michigan director is Edwin Henwood, of Hancock, who has labored diligently in securing the reorganization.

The history of the Oneida, under its preceding names and managements, is one of misdirected effort and wasted fortunes. Known originally as the Northwest, the mine was opened on a fissure also called the Northwest. Five other fissures were discovered and several developed to a limited extent. The Northwest Copper Association was organized in 1847 and owned 4,320 acres in all, lying south of the greenstone. The stamp rock taken from the fissures was of limited quantity and rather poor quality, but some fine masses were found, the largest weighing over ten tons. These masses were usually found in the country rock, close to the veins but not actually incorporated therein. The concern was reorganized as the Northwest Mining Company in 1849, and a small stampmill run by water power was built in the spring of 1850. The mill proving inadequate, it was replaced by a mill with 24 Cornish stamps, run by steam power, two years later. This was one of the first steam-power mills in the district, and the average yield of ingot copper from the fissure vein-matter stamped was 27.4 pounds per ton—equivalent to 1¼ per cent, and was secured at a cost of $4.42 per ton for mining and milling. The Atlantic has done similar work at a cost of but a cent or two more than an even dollar, within the past decade, though at present the Atlantic's costs are greater, owing to higher wages paid labor and advanced prices for material and supplies of all kinds. A heavy hoisting engine—at that time the most powerful in the district, though it would now be considered a toy—was installed in 1852, and some idea of the difficulties of pioneer mining may be formed from the time taken to transport the machinery from Pittsburg to the mine, four full months having been consumed in transit.

In the three years 1849 to 1851 inclusive, the Northwest made 261 tons 541 pounds of refined copper. The cost of production was about $175,000 and the metal was sold for $94,819.83. The same amount of copper at the present market price of 17 cents would be worth almost $90,000, and could probably be produced for half the cost of the copper made 50 years ago, leading to the belief that possibly the old Northwest, Stoughtenburgh and Hogan fissures would be worth giving attention to, if active mining is resumed.

An attempt was made to sell the property in England in 1852, but was not successful. The Northwest company continued work, under the disadvantages of a deficit, until 1861. The total expenditures were $611,000 and receipts, from copper produced, were $328,000. The financial stress proving too much for the directors, who had personally ad-

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vanced considerable sums and guaranteed the paper of the Northwest company, a reorganization was effected in 1861, under the name of the Pennsylvania Mining Company. The Pennsylvania company had a short and inglorious career, and instead of bettering the record of its predecessor, did far worse. The old workings were abandoned and new shafts sunk on the Eagle, Branch and Trotter veins. A new stamp-mill, the largest in the copper district, was built on Lac La Belle, and expensive hoisting machinery and gravity trams installed. All these improvements were effected before the new openings became producers, at a cost of $126,000. The Pennsylvania company found itself in sorer straights financially within two years than its predecessor had ever been, and another reorganization was proposed, but the matter was compromised by setting off 720 acres from the west side of the property, and organizing a company thereon under the name of the Delaware Mining Company. There was a bit of high finance in connection with this arrangement, by which the shareholders of the Pennsylvania were relieved from the urgent necessity of a heavy assessment, and bonds to a large amount were issued by both the Pennsylvania and Delaware companies. From the date of the successful organization and financing of the Delaware company, lavish expenditures were the order of the day. A big new mill was built for the Delaware at Lac La Belle, the two mills, with their equipments costing about $200,000—an unprecedented figure for the early days. Very large sums were expended, amounting to $2,000,000, according to the estimate of Prof. C. D. Lawton, for some years Commissioner of Mineral Statistics of Michigan.

In 1866 the bondholders grew restive. The two companies had expended fortunes in surface work, and were prepared to handle the rock from a small Calumet & Hecla, but the underground developments had been neglected and the mines were very small producers. It being apparent that no returns could be looked for from the Pennsylvania and Delaware companies, the bondholders took possession of both properties under their mortgages in 1866, and operated the mines for two years. Finding that they were merely throwing good money after bad, the bondholders sold their rights to Ed. M. Davis, of Philadelphia, in 1868. The amount of work done under the Davis regime was small, no copper being produced from the Pennsylvania after 1867, when the maximum output of 163 tons 660 pounds was secured by the bondholders. The Delaware was idle from 1865 until 1872, when production was resumed on a small scale.

In 1876 a reorganization was effected by which both the Pennsylvania and Delaware companies were merged, under the title of the Delaware Copper Mining Company. Work was begun by the new corporation on the Delaware vein, but the results not proving encouraging, activity was transferred to the old Stoughtenburg fissure, on which the Northwest had opened extensively in the years 1858–1862. Beside mining from the fissure, some opening was done on an amygda-

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loid lode crossing the fissure at nearly right angles, and some rock stoped therefrom.

In 1880 the reorganized Delaware found the task too heavy for its powers and a new company was formed, under title of the Conglomerate Mining Company, which took possession at the beginning of 1881. A conglomerate lode underlying the greenstone had been found to carry copper, and the new company was organized to exploit this lode.

The Conglomerate company started work on a scale of lavishness previously unknown in the copper district, although the old Northwest, Pennsylvania and Delaware companies had managed to go through a couple of million dollars in about a third of a century. The Conglomerate company became possessed of the holdings of the Mendota company and other mining locations in that vicinity, thus acquiring a landed estate of a little more than 20,000 acres of land—nearly 30 square miles all told.

Despite the unbroken record of the past, when all the mills and surface improvements were on too large a scale for the mine, another new mill was built, on Lac La Belle, of stone, and fitted with three Ball stamps and a seven-mile railway connecting the mine and mill was constructed and equipped. The railway equipment was of the best, including two locomotives and a large number of rock cars. Fine mine buildings were erected, and 114 dwellings constructed. A fifty-drill air compressor was installed and the best of everything in the way of machinery purchased. The shafts were made 10 x 14 feet, and all drifts were opened to the unusual and unnecessary size of 9 x 12 feet. But little attention was devoted to the old workings, the efforts of the company being devoted to the opening of a large mine on the conglomerate underlying the greenstone. That this is the Allouez conglomerate seems reasonably certain. The lode is wide, averaging probably 25 feet, and can be economically mined. Unfortunately it is not rich in copper. In the year 1882 only 56 per cent of the lode-rock broken was stamped, and the return from the portion stamped was $^{81}/_{100}$ of 1 per cent ingot copper for that year. Expenditures were on the most lavish scale. A ship canal was dug, connecting Lac La Belle with Lake Superior, and the surface work was done in the most solid and costly manner—a policy highly commendable for a developed mine, but of dangerous nature for mines that are not yet proven.

In 1883 Mr. Chas. H. Palmer was appointed agent of the mine. His administration of its affairs were marked by prudence and ability, but the damage had been done before he was called in. The expensive surface work was discontinued, with the exception of finishing up some of the jobs nearly completed, and every effort made to open a large and paying mine on the conglomerate. This plan was successful so far as securing extensive openings was concerned, but the best management and the strongest treasury cannot put copper in rock where nature omitted placing it. In 1884 a total of 120,868 tons of

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rock was stamped, yielding 1,140,173 pounds of refined copper; a return of 47/100 of 1 per cent ingot. Mr. Palmer milled much of the rock of low grade that would have been discarded by his predecessors, a policy undoubtedly correct, as the total cost of milling, after the rock was hoisted, was but 60 cents per ton. The total ton-cost for rock stamped in 1884 was only $1.58, the items of cost being 88 cents for mining and hoisting, 19 cents for transportation, 41 cents for stamping and 9 cents for general superintendence. This was a fine showing, and the costs were less than that of most Lake Superior copper mines at the present day, but the returns of refined copper were but 9.43 pounds per ton of rock, which, at the average price of 13 cents for the metal in 1884, gave a net return per ton of only $1.22. With copper at the present price of 17 cents per pound, a net profit of 2¼ cents per ton would be earned upon the same costs.

The Conglomerate Mining Company expended $1,300,000 over and above its receipts from copper produced in the three years 1881–84, closing down at the end of the latter year. In 1888 the property was reorganized as the Lac La Belle Mining Company, but no effort was made to resume mining. Early in 1898 an option was secured by Edwin Henwood, of Hancock, and a company known as the Pawnee was partly organized in Boston late in that year, to take over the mine; but the deal fell through and the Pawnee organization was not perfected. The Oneida Copper Company, the present owner of the property, was incorporated, as before stated, in November, 1899.

The plant of the Oneida is much the most valuable possessed by any idle mine in the Lake Superior Copper District. The principal items, and their actual cost, are as follows:

Stampmill, with machinery	$184,000
Railroad and equipment	146,000
Hoisting plant, buildings and boilers	70,000
Compressor plant and building	62,000
Total	$462,000

In addition to the above is the value of the 114 dwellings on the company's lands, and some miscellaneous mine buildings, such as dryhouses, machine shop, blacksmith shop, warehouses, etc. The total expenditure on surface by the Conglomerate company was $685,000. The money was economically spent, though the expenditure was most unwise. Since the suspension of work at the mine, at the end of 1884, Capt. W. R. Vivian has been constantly retained as local superintendent and caretaker. His services have been worth at least a hundred thousand dollars to the property, should it again be worked. The dwellings have been kept in fair repair and every mine building and piece of machinery has received his careful attention. The idle machinery has been painted and is today as free from

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rust as when the mine whistle sounded for the last time, sixteen years ago—probably more so, as Mr. Vivian has made his work a labor of love, and retains undiminished confidence in the ultimate resumption of work at the "Delaware," as the mine is still generally called in the copper district.

Of the estate of nearly 21,000 acres owned by the Oneida Copper Company, 3,685 acres are on the mineral belt, and this tract is crossed by every known cupriferous lode of Keweenaw County existing south of the greenstone, and it is south of that massive range of greenish trap rock that most of the important copper discoveries of Keweenaw Point have been made. Nearly a score of lodes and copper-bearing fissures have been located and actual mining done upon six or seven of them. Under the Henwood option, and since the organization of the Oneida company, some exploratory work has been done on two amygdaloid lodes, both carrying copper in promising amounts. One of these lodes outcrops near the mill, the other near the old mine workings. One of these amygdaloids is believed to be the Kearsarge.

It is probable that under favorable circumstances some mining might be done to advantage on the conglomerate where the Conglomerate company expended more than half a million dollars in opening work, in addition to the surface improvements. In connection with a paying amygdaloid lode, the conglomerate could be worked very cheaply, but an attempt to work the conglomerate alone would be ultra-hazardous, in view of the past history of that part of the mine. In connection with a paying amygdaloid lode, if such could be opened, some attention might be devoted to the Stoughtenburg mine at the same time, with fair prospects of securing a profit therefrom, if stoped in connection with other openings.

ONONDAGA.

It was proposed to reorganize the old Shelden & Columbian property, in Houghton, under this name, in the spring of 1899, but the reorganization was not effected.

OPECHEE.

A property on which only a little exploratory work had been done previous to its incorporation with the Osceola in 1879. It forms the southern end of the present Osceola mine of the Osceola Consolidated Company.

OSCEOLA.

A portion of the Osceola Consolidated, treated under the heading of active mines.

PACIFIC.

A tract of 960 acres of mineral land in 54-34, north and west of the Atlantic.

PAWNEE.

See Oneida.

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PEAK.

The Peak Copper Company was organized under the Michigan laws in October, 1899, with an authorized capital of $2,500,000; W. L. Laffer president and H. T. Carleton secretary, with offices in Cleveland. The property consists of 640 acres, being all of 32-49-46. The property is located about six miles north of Bessemer, an important mining town in the Gogebic Iron Range. Three cupriferous lodes have been located, two of which are amygdaloids and the third a conglomerate. Some exploring has been done since the organization of the company, on both conglomerate and amygdaloids, mainly in the form of shafts of shallow depth. It is also proposed to drive an adit to connect with the principal shaft. Some good specimens of copper rock have been secured from the property and the lodes are of fair width.

PENINSULA.

Successor of the Albany & Boston. Organized 1882, mine closed 1892. Property sold in 1895 to the Franklin, and now known as the Franklin Junior,

PENN.

Now part of the Belt Mines.

PENNSYLVANIA.

Previously Northwest, later Delaware. See Oneida.

PETHERICK.

Became the Ashbed. See Ashbed in list of active mines.

PEWABIC.

Opened 1852, closed 1884. Officials allowed the charter of the company to lapse, and a controlling interest in the property was secured by T. F. Mason, president of the Quincy company, at whose instance the affairs of the Pewabic were wound up and the mine sold to Mason for $710,000, and by him sold to the Quincy company for $1,000,000, to the great profit of both purchaser and buyer. Is now known as the "North Quincy" portion of the Quincy mine, lying immediately south of the Franklin.

The Pewabic company has paid dividends of $1,000,000 and has considerable assets yet remaining, although the company has been in liquidation for about thirteen years. The Pewabic and Franklin companies were under the same management and practically operated as one property. When control of the Pewabic passed to adverse interests, great differences of opinion arose as to the proper settlements of the accounts between the two mines, which adjoined, were connected underground, and had been worked under the same eastern and local management for many years. The Pewabic company claims about $200,000 from the Franklin company, and has secured verdicts for large

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sums, which have been set aside in the higher courts. The Franklin also has a claim against the Pewabic company for pumping, cash advanced, and other items. At the present rate of progress it seems probable that the litigation will be finally disposed of sometime during the twentieth century.

PHILADELPHIA & BOSTON.

Owns Section 14, in Town 58, Range 28, Keweenaw County.

PHOENIX.

See Phoenix Consolidated, in list of active mines.

PISCATAUQUA.

Became the Bohemian. Sold to that company in 1853 for $3,000. See Bohemian and Belt.

PITTSBURG.

A tract of 480 acres in the Norwich district, west of the Ontonagon River, on which a little work was done, beginning in 1852 and ending in 1856. Three shafts were started, on as many different lodes, and sunk to depths of 15, 60 and 80 feet.

PITTSBURG & BOSTON COPPER COMPANY.

Opened and operated Cliff mine. See Cliff.

PITTSBURG & ISLE ROYALE.

One of the pioneers on Isle Royale, being antedated only by the Ohio & Dead River Company. In 1846 was working on Section 12, 65-36, on a fifteen-foot lode of amygdaloid. The largest piece of copper secured therefrom weighed just sixteen ounces. Another bed of amygdaloid averaging a foot in width carried copper in considerable quantities, mainly in sheets between the lode and footwall, one considerable mass having been found there.

PLUTUS.

A property adjoining the Eureka or Merryweather, and with the latter used in floating the Wahnita in the winter of 1898-99.

PONTIAC.

Next northeast of the Mesnard, organized in the same period and only a little exploratory work done on the property. Was bought by the Quincy in 1895 or thereabouts, and is now the northern portion of the Quincy. The Pontiac carries extensions of the Pewabic, Mesnard and Hancock lodes.

PORCUPINE MOUNTAIN.

The Porcupine Mountain Mining Company was organized in 1860, on the east half and southwest quarter of 28-51, near Carp Lake. The

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location is two miles south of Lake Superior and 1,000 feet higher than the lake, in a magnificently rugged country, the scenery of which is a sort of replica, on a reduced scale, of the grand features of land and water found in the vicinity of Thunder Bay, on the north shore of Lake Superior. The Porcupine Mountain company sunk a few shallow shafts only, and found nothing of importance.

PROVIDENCE.

Organized in 1863 on 240 acres adjoining the Delaware, in Keweenaw County. Did but a small amount of exploratory work, and that without results.

RED JACKET.

Started a vertical shaft, near where the Light Guard armory now stands, in Calumet, in the late sixties, to intercept the Calumet conglomerate. Was absorbed by the Calumet & Hecla.

RESOLUTE.

This property consists of 1,120 acres of land on the mineral range, in Keweenaw County, being described as the south half of Section 7, all of Section 18, and the north half of the north half of Section 19, 58–29. The property is at present owned by the Resolute Copper Company, organized under the Michigan laws with a paid-up capital of $25,000, divided into 1,000 shares of the par value of $25 each. J. F. Carey, of Escanaba, Mich., is president; John D. Cuddihy, of Calumet, vice president; A. F. Heidkamp, of Lake Linden, secretary, and J. L. Nankervis of Calumet, treasurer. In the latter part of 1899 and following winter the mine was unwatered, the shaft retimbered, and a few necessary buildings erected on the location. The shaft is 379 feet deep and the mine contains nearly 2,000 feet of drifting on various levels. The work of the old Resolute company was directed toward securing mass and barrel copper from the numerous cupriferous fissure veins found on the property, and no attempt was made to open any stamp lodes or veins. Several promising amygdaloid lodes were cut by the old drifts on the fissures.

RIDGE.

A dividend-paying property of the early days, credited with disbursing profits of $100,000 to shareholders. Opened about 1852 and closed in 1881, but worked in a small way by tributors from 1881 until 1898, when absorbed by the Mass Consolidated. Has produced about 3,000 tons of refined copper. See Mass Consolidated.

ROCKLAND.

One of the heaviest producers of Ontonagon County from 1856 until 1865, after which year it continued production on a small scale, on tribute, until 1879. Produced 3,105 tons 309 pounds of refined copper. Is now part of the Michigan.

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SAGINAW.

Worked from 1875 until 1879 on 35-66-34, Isle Royale. Produced in all 25 tons 1,264 pounds of refined copper.

ST. CLAIR.

Organized in 1863. Sunk 300 feet and opened four levels. Built a 12-stamp mill in 1872. Reorganized by creditors in 1880. Also sunk a shaft 600 feet deep to eastward of main workings. Made 505 tons 1071 pounds of refined copper. Now part of the Phoenix Consolidated.

ST. LOUIS.

A tract of 800 acres in Sections 19 and 20, 56-32, next south of the Old Colony, east of the Laurium, and southeast of the Calumet portion of the Calumet & Hecla. Owned by the Calumet & Hecla.

ST. MARY'S COPPER COMPANY.

Organized in 1863 from lands of St. Mary's Canal Mineral Land Company. Sunk three shafts in the Mesnard epidote, to depths of 50, 75 and 100 feet, respectively. The company was organized at the same time as the Pontiac and Mesnard, and its inception was due to the same cause, namely, the finding of the big mass of copper taken by prehistoric miners from the Mesnard epidote lode. The St. Mary's property was acquired in 1899 by the Arcadian.

SALEM.

A tract of 240 acres of mineral land in 33-58-31, Keweenaw County.

SCHOOLCRAFT.

Organized in 1863 on the section immediately north of the Calumet & Hecla, which was then undiscovered. Shut down in 1873 and became bankrupt in 1876. Was bought by a company organized for that purpose, which took the name Centennial from the date of its organzation, the year being the hundredth anniversary of the independence of the United States. See Centennial in list of active mines.

SENECA.

A tract of 1880 acres just north of the Mohawk and Ahmeek Present developments indicate that the Kearsarge amygdaloid lode, on which the Mohawk is opened, may outcrop on the extreme southeast corner of the Seneca's most easterly tract, the northwest quarter of 23-57-32. This is not certain, as the eastern deflection of the mineral range, which threw the Kearsarge outcrop onto the Fulton (now Mohawk) lands, instead of on the Ahmeek, to the westward, where it was looked for, may further deflect the strike of the lode to the east, in which case it would outcrop on the lands of Bacon & Jacob and lands of St. Mary's Canal Mineral Land Company. There is even a likelihood, judging from the contour of the eastern sandstone, that

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the lode may outcrop on the 320-acre tract of land in Section 24, the surface of which is owned by the Osceola company, with mineral rights held by the Union Copper, Land & Mining Company. In the latter case the value of the Union lands would depend not only on the appearance of the lode at that point, but also on the exact location of the outcrop, as there might or might not be enough of the underlay of the Kearsarge on that tract to afford the basis for a mining organization having reasonable prospects of success. Even eighty acres of the Kearsarge lode, as rich as at the Wolverine or Kearsarge, would make a profitable, though not a long-lived mine. The Union also owns 400 acres just north of the Seneca, in Sections 14 and 15, which can hardly have the outcrop of the Kearsarge, but undoubtedly has the underlay. The lands north of the Mohawk are badly cut up, as held at present, and complete rearrangement of the present lines would be advisable in case an attempt were to be made—as it undoubtedly will be at some time in the future—to open a mine on the extension of the great Kearsarge lode to the north of the Mohawk.

The Seneca is at the southern edge of the prominent outcrop of the greenstone ridge which is such a noticeable feature of Keweenaw County, geographically and mineralogically. The Ahmeek was set off from the Seneca in 1880. Two shafts were sunk to the depth of 200 feet each, by the Seneca, in the same year, since which time there have been no attempts made at mining or exploratory work.

SEWABIC.

Consolidated with the Osceola on the organization of the latter, in 1873.

SHARON.

Had 160 acres, the southeast quarter of 9–49–41, two miles west of the Norwich, on which two shafts were sunk to depths of 80 and 110 feet, and about 150 feet of drifts run, in 1852 and the two following years.

SHAWMUT.

A little work was done on the property in 1856–57. Became the Everett. See Everett.

SHELDEN.

A small property on the southern shore of Portage Lake, in the village of Houghton, just north of the Columbian. Consolidated with the latter in 1864.

SHELDEN & COLUMBIAN.

Formed in 1864 by the merging of the Shelden with the Columbian (formerly Albion) mine. A two-stamp mill, run by steam power, was built in 1866. The company suspended work in 1870, and the mine

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was thereafter worked on tribute for a number of years. The property contained considerable silver, especially in the northern shafts. The mine was opened on the Grand Portage and Isle Royale lodes, principally the former. Other cupriferous lodes have been found in excavating for streets and buildings in Houghton. The mine has produced 703 tons 724 pounds of refined copper.

SHIRLEY.

Set off from the Forest in 1852, and absorbed a few years later by its parent. Was the east half of 36–50–39.

SILVER CREEK.

A tract of 800 acres in Sections 2 and 3, 58–28, near the end of Keweenaw Point.

SISKOWIT.

The Siskowit Mining Company begun operations as early as 1845, on 13–66–34, near Rock Harbor, Isle Royale, on an epidote lode averaging 5 feet wide and carrying sheet copper in contact with both walls. A shaft was sunk about 500 feet, at which depth the lode was lost. The mine was closed in 1855, after ten years activity, during which it made about 150 tons of copper. Capt. William Tonkin, later superintendent of the Atlantic, and now retired and living in England, thinks a good mine might have been made of the Siskowit by sinking the shaft another hundred feet or so, at which depth he believes the lodes known as the east and west veins would have come together.

SOUTH KEARSARGE.

See Osceola Consolidated.

SOUTH PEWABIC.

The South Pewabic Copper Company was organized in 1865, to open a mine on what was believed to be the southerly continuation of the Pewabic lode, on which the Franklin, Pewabic and Quincy mines were previously opened. The lode proved to be the Atlantic ashbed, and not the Pewabic amygdaloid. In the first three years' operations the company spent $497,000, and eventually sunk very nearly a million dollars. The company finally went into bankruptcy, and the South Pewabic and Adams mines were bought by the Atlantic Mining Company, organized for that purpose, which corporation has paid dividends of $860,000, and is apparently good for several millions in dividends in the future.

SOUTH RANGE.

The South Range Mining Company owns 4,000 acres of undeveloped lands on the mineral range, lying between the Globe and Belt properties, in Houghton and Ontonagon Counties, there being nine

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different tracts, ranging in size from 80 to 480 acres each. The office of the company is in Houghton; R. R. Goodell, president, and F. W. Nichols secretary.

SOUTH SIDE.

This is a tract of nearly 200 acres, lying just west of the Dacotah and north of the Naumkeag, with a frontage of 2,640 feet on Portage Lake. Some gophering in the way of opening test-pits and adits was done in the sixties.

STANDARD.

The name of a syndicate organized in the winter of 1898–99 to explore a tract of 1,080 acres of land lying west of the Calumet & Hecla and Tamarack mines, in Sections 9, 16 and 17, 56–33. A limited amount of work was done. Some conglomerate drift, rich in copper, has been taken from this tract.

STAR.

A tract of 720 acres of land, lying in Sections 9, 10 and 16, 58–28, Keweenaw County, between the Clark and Copper Harbor properties.

STONINGTON.

A property adjoining the Everett or Shawmut mine. A small amount of copper was taken from an adit in 1856. See Everett and Kaukauna.

STOUGHTENBURG.

See Oneida.

SUMMIT.

East of Dana and adjoining the Copper Falls mine. Became the Madison. See Madison.

SUMNER.

See Hancock.

SUPERIOR.

A tract of 945 acres carrying the Evergreen and other cupriferous lodes of Ontonagon County. Sold to the Michigan company by the receiver, for $10,500, in December, 1899.

SUSSEX.

Organized in 1864 on 800 acres in 58–30, south of the greenstone, in Keweenaw County. No developments.

SYLVAN.

In the Victoria district, west of the Ontonagon River. Organized in the middle fifties. Little development. Absorbed by the Victoria.

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TAMARACK JUNIOR.

Absorbed by the Osceola Consolidated in 1897.

TOLTEC CONSOLIDATED.

Organized in 1850 on a 320-acre tract consisting of the south half of 25-51-38, just north of the Hilton, which latter is now part of the Adventure Consolidated. Begun mining in 1851 and found one mass of 12 tons native copper. Worked ten years and produced 206 tons 1,443 pounds of refined copper at a loss of about $500,000.

TOMAHAWK.

The Tomahawk Mining Company was organized in 1872, by Edwin J. Hulbert and others. It was formed to work the Tomahawk lode, which "got lost." Like all lost mines, it became the richest thing of its kind ever discovered, immediately after being lost—a conglomerate carrying more copper than the Calumet lode. There are many who think that the discoverer mistook a boulder of conglomerate drift for conglomerate in place, but Mr. Hulbert scouts this idea, and being a man of very positive opinions, with a taste for controversy and a disposition to use his talents to the discomfiture of his adversaries in an argument, the present writer does not vouch for the correctness of the opinion of those who differ with the famous discoverer of the Calumet conglomerate and the Tomahawk lode.

TOMAHAWK JUNIOR.

Articles of association of a Tomahawk Mining Company were filed with the Secretary of State at Lansing in May or June, 1899, but it coming to the cognizance of the incorporators that they had unwittingly appropriated the name of a corporation yet retaining legal existence, though long since moribund, the articles were amended so that the name of the company was made the Tomahawk Junior Mining Company. The directors of the Tomahawk Junior Company are Messrs. Fay, Mosman, Watson and Dow of Boston, and Chynoweth of Calumet, all of whom are prominent in the so-called Fay group of Lake copper mines. It is not known that the company has acquired property, and it has certainly taken no steps toward reopening any of the old Keweenaw mines, for which purpose it was formed.

TORCH LAKE.

This property consists of 1,280 acres, being all of Sections 35 and 36, 56-33, and lies midway between Calumet and Lake Linden. All but about 100 acres of the property is on the mineral belt, on the eastern side of the range. The company was organized with 20,000 shares only, and no attempts have been made to place stock on the market or to boom the property. An assessment of 50 cents per share was levied early in 1900, to provide necessary funds for exploratory purposes. A small crew

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of men, about twenty in number, was worked by Capt. John Wealton in the summer and fall of 1899, under the superintendence of W. W. Stockley, of Hancock. Since that time some diamond drilling has been done, apparently in a systematic and business-like manner. If any discoveries of importance have been made by the drill borings, they have been effectually concealed from public knowledge.

TREMONT.

A tract of 320 acres, next west of the Devon, in the Victoria district, Ontonagon County. Comprises the southeast quarter of Section 26 and the northeast quarter of Section 35, Town 50 North, Range 39 West. No development.

UNITED STATES.

One of the numerous crop of trans-Ontonagon "mines" organized in 1852. Lands are located in 34-51-40. Very small amount of desultory surface-scratching done in 1853 and 1854.

VALLEY (No. 1).

A tract of 160 acres on the mineral range, in Keweenaw County, being the east half of the northwest quarter and the west half of the northeast quarter of 14-57-32. No mining development on the lands.

VALLEY (No. 2).

The name given to some lands owned by Messrs. A. Kauth of Hancock and Daniel Crawford of Detroit, at the time of the copper boom of 1898-99. Lands located in the Winona district. No organization effected.

VICTORIA.

See Forest; also Victoria in list of active mines.

VULCAN.

A tract of 1,520 acres in Sections 7, 8, 17 and 18, 58-27, Keweenaw County, near the end of Keweenaw Point. Never a producer.

WAHNITA.

A rank "wildcat," organized in the winter of 1898-99 by Boston parties on the old Plutus and Merryweather properties, west of the Ontonagon River. A considerable amount of stock was disposed of, and the munificent sum of $500 was devoted to exploratory work, after which the eastern management lost interest, and announced that some phenomenally rich copper claims had been secured in Arizona, and that the Wahnita, instead of being made another Calumet & Hecla, as first intended, would be developed into a second United Verde. Some of the Lake Superior shareholders became convinced that the company was a wildcat, and instituted the necessary legal steps to secure an

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accounting. The matter was compromised by the Wahnita company deeding back to the lake shareholders the Plutus and Merryweather lands. The Wahnita therefore has no further interest in Lake Superior, and Lake Superior people have no further interest in Wahnita, except to hope that neither it nor any of its ilk will again invade this district.

WATERBURY.

The east half of 17-58-30, Keweenaw County. Some mining work was done on this tract in 1850-54, without finding anything of value. The property is now a part of the lands owned by the Eagle Harbor company.

WAUKULLA.

Consists of 480 acres near Lake Gogebic, in Ontonagon County, in Sections 19 and 20, 49-42. Some exploring work was done in the latter seventies, being confined principally to the driving of an adit for a short distance into a bluff. Nothing of value was found.

WENDIGO.

The last mining on Isle Royale was done by the Wendigo Copper Company, from 1890 to 1892. The Wendigo company was an offspring of the Isle Royale Land Corporation, the English company owning 84,000 acres of mineral lands on the island. Exploratory work was begun by the last named concern in the summer of 1889, on Sections 11, 12 and 13, 65-36, and also on 7-65-35, near the head of Washington Harbor. These lands were turned over to the Wendigo company upon its organization in 1890, and some mining work done thereafter, though the greater part of the outlay made on the Wendigo was for diamond drill borings, which were discontinued in the late fall of 1892. A total of 9,000 feet of drill holes was bored, and as this work was done with discrimination and upon a plan excellently devised to thoroughly test the territory covered, the borings have thrown much light upon the geology of Isle Royale, though unfortunately they did not result in opening a mine on the Wendigo property.

In 1896 Jacob Houghton, of Detroit, superintended some further exploratory work on the Wendigo lands, but a bank failure in Duluth tied up the funds devoted to the work at a critical stage, and work was stopped. In 1898 and 1899 some further exploratory work was done on the island under the superintendence of Mr. Houghton, for Col. Frank J. Hecker and his associates, of Detroit, but the work was dropped before decided results of any sort were obtained.

There are many fascinating features about Isle Royale. The geological problems are of deep interest to scientists, and the remarkable electrical currents traversing the entire length of that long and narrow body of land are well worthy of extended investigation.

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WEST MINNESOTA.

This property consists of about 550 acres, in Sections 18 and 19, 50-39, lying mainly west of the Ontonagon River, but the actual mining work was confined to the northeast quarter of Section 19, on a line with the strike of the shafts of the Minnesota and National mines, in the hope of intercepting the contact vein on which those mines were opened. About $10,000 was spent in the quest in 1854, without success.

WHEAL KATE.

A tract of 240 acres lying immediately west of the Section 16 lands of the Atlantic, in 17-54-34. The little mountain known as Wheal Kate, one of the highest points of land in the state, is located on this property, which took its name from the hill with the Cornish name. A limited amount of exploratory work was done on the lands in the sixties. The property carries the underlay of the Baltic, but at such vast depth that its value is problematical.

WHITE PINE.

This property is in the Porcupine Mountain district, about two miles from the Nonesuch. The fee of its lands is owned by St. Mary's Canal Mineral Land Company. The mine was opened in 1881 and closed in the following year. There are 80 acres in the tract, which consists of the south half of the southeast quarter of 5-50-42. One shaft is down to a depth of 170 feet and there are four shallow pits, all bottomed in copper-bearing rock. The lode of the White Pine is that of the Nonesuch, and the characteristics of that mineral body are much the same in both mines. For further reference to this lode see Nonesuch.

WINDSOR.

A property adjoining the Norwich, organized in the fifties, and absorbed by the Norwich in 1863.

WINTHROP.

This property comprises 800 acres in Sections 22, 23, 26 and 27, 58-31, Keweenaw County. A mine was opened on a fissure vein in Sections 23 and 26, in 1852, and work was continued for several years thereafter. The company expended $90,000, raised by assessments, and stopped work about 1859 or 1860. The affairs of the corporation were wound up and the property sold by the receiver to L. C. Palmer, of Marquette, Mich., for $4,850, on Jan. 29, 1900.

WYOMING.

Organized in 1865 by the Pennsylvania company on a tract of 1,280 acres south of Mosquito Lake, Keweenaw County, near the erstwhile flourishing town of Wyoming. Very little work was done on the property, which was a sort of kite-flying device put out by the Pennsylvania

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to aid in tiding that corporation over a period of great financial stress. The property lapsed back into the hands of the original owners, and became a portion of the Delaware, now the Oneida.

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Active Copper Mines.

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Active Copper Mines.

In the preceding section I have listed nearly two hundred inactive mines and mining companies. Some of the mines so listed are important properties; others have long ceased to be of any particular account; and many are out of existence, through the absorption of their lands by other mines, or the death of the corporations. The list will prove of value, however, for reference purposes, now and in the future, as no list so complete has heretofore been compiled.

In the following pages, the active mines of the Lake Superior Copper District will be given consideration. The inactive concerns were listed alphabetically, for there seemed no other plan feasible, as to attempt a description in geographical order would have caused insufferable confusion. The three copper bearing counties of Michigan form a chess-board on which many games have been played, and some tracts of mineral lands have been owned by nearly a score of different corporations, from first to last, and have formed parts of many mines, or attempts at mines.

In the case of the active properties, the situation is entirely different. In considering these we are dealing with the surveyors' lines of the present day, and for several reasons, chief among which is the desire to give a better understanding of the situation by means of a semi-connected though discursive trip from one end of the copper district to the other, it has been deemed much the best plan to start at the beginning of the copper district, which may safely be placed at the tip of Keweenaw Point, where the Keweenawan copper measures sink below the waters, and to traverse the district to the other extreme of activity, west of the Ontonagon River, describing the principal features and giving the principal statistics of each mine, in order as passed.

While the plan of geographical order has many advantages, it has the single drawback of sandwiching the more important mines in the middle of the journey. For readers who wish to give consideration to certain individual mines only, or to those who thirst for ponderous figures and stupendous facts, a carefully prepared index at the end of the book affords the means of skipping the uninteresting chapters and striking right into the dividends of the Calumet & Hecla, the great depth of the Tamarack, or the absorbing narrative of the

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Quincy. To those who have the time, it is suggested that the descriptive chapters devoted to the active mines be read in order. There is a connecting thread of interest, not always readily apparent, but yet existing, and it is probable that a better idea of the wondrous Lake Superior Copper District as a whole may be obtained by following the same route that has been taken in the writing of the pages that follow, than by any other system of reading this work.

CLARK.

It is a somewhat surprising fact, and one apt to disconcert the trustful reader, that the first mine to be treated among the active copper properties is not mining copper at all, and its management has no present intention of attempting to do so. As it always has been a copper mine, and is the only property in the district presented in this anomalous manner, the reader is asked to look at the paradox as merely a sort of backing up, preparatory to taking a better start.

It happens that the old Clark mine is the most easterly property on the Keweenaw Peninsula at which any mining work is now being done. The mining of the present day, however, is for manganese, and not for copper.

The present Clark comprises properties known in the past under the names of the Clark, Bell, and Montreal mines, and a large part of the landed area once held by the French Copper Mining Company, of Paris. The area of the property is about 1900 acres, and it is located in Town 58 North, Range 28 West, south of Copper Harbor and Lake Fanny Hooe, a body of water two miles long and averaging a remarkably constant width of a quarter of a mile. Lake Manganese is included within the territory of the mine.

The first mining—for copper—was done in 1858. The company owning the property coming to grief three years later, the Clark was purchased from the bankrupt French Copper Mining Company by Edouard A. J. Estivant, of Paris, who still owns it. The principal work was done in the middle seventies, when a mill with sixteen gravity stamps was built half a mile from Lake Manganese, and operated by water power therefrom. The total production of copper was about 94 tons.

A cargo of 800 tons of manganese ore was taken from the mine in 1881, and another lot of about 400 tons was secured two years later. The manganese ore of the Clark has been described by various writers as a peroxide and as a protoxide—manifestly impossible. So far as may be judged without more complete assays, it is a form of pyrolusite with which more or less silica is intermixed, and possibly containing other impurities. It has been stated that the manganese mined in the early eighties gave bad results, owing to the excess of iron contained therewith, but this was evidently a mistake, as the main commercial use of manganese is in the form of spiegeleisen and ferromanganese, for toughening steel. Manganese is usually found in more or less close association with iron.

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The exact width and condition of the manganese vein is unobtainable at present. According to the recollection of Mr. John H. Gatiss, of Eagle River, who is perhaps the best posted regarding the old copper properties of Keweenaw County of any resident of that district, the Clark deposits of manganese ore are in the nature of pockets, rather than in the form of a continuous vein. This and other points regarding the property will probably be settled by the systematic work which is now under way at the old mine, under the superintendence of Mr. S. W. Osgood, Jr.

The old workings are being unwatered, and it is expected that 50 or more men will be worked in the mine and about the surface during the winter of 1900–1901. At present the principal source of manganese in this country is from the manganiferous iron ores of the Lake Superior iron ranges of Michigan and Wisconsin, where ores running occasionally as high as 17 per cent in manganese are found—the usual average being perhaps 4 per cent.

WASHINGTON.

The next active property west of the Clark is the Washington mine. This is an old incorporation, on which more or less work of an exploratory nature has been done from time to time. The Washington Mining Company was moribund for some years, until galvanized into life during the big copper boom of 1898–99, at which time an assessment was levied and a few men set at work on the lands of the company, which consists of about 800 acres in Sections 4, 5, 8, 9 and 15, Town 58 North, Range 29 West. The property is about seven miles west and south of Copper Harbor and lies mainly on the western shore of Mosquito Lake.

The capital stock of the company was increased from 40,000 shares to the maximum of 100,000 shares allowed under the Michigan laws, in May, 1899. Of the new stock, 20,000 shares were offered to previous stockholders at $2.50 per share, for raising a treasury fund, and 40,000 shares were placed in the treasury for further use. The receipts in 1899 from the sales of treasury stock first offered were $30,280, and the expenditures were $13,669, of which amount $7,873 was for labor, material and taxes, leaving the company with $16,608 cash on hand at the beginning of the year 1900. The actual work at the mine in 1899 consisted of digging 1,782 feet of trenches across the formation, sinking a shaft 194 feet and drifting 236 feet. A shaft was sunk 136 feet on what is called the ashbed lode, though it cannot well be the ashbed of the Arnold to the west. The lode is very wide, but mineralized in patches only. Much trouble has been experienced from water in both 1899 and 1900, these seasons having been phenomenally wet. Two shallow shafts have been sunk in amygdaloid lodes carrying copper, and several fissures showing metal have been cut. At present work is being confined to an adit which is proving the formation. H.

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F. Fay is president of the Washington company, Capt. Jas. Chynoweth of Calumet superintendent, and John Ford is mining captain and in personal charge of the work at the property.

ARNOLD.

The Arnold Mining Company owns a tract of 3,323 acres, in Sections 1, 2, 10, 11, 12, 13, 14, 15 and 23, Town 58 North, Range 31 West; also the northwest quarter of the northwest quarter of Section 7, Town 58 North, Range 30, lying immediately east of the main tract and near the Owl Creek mine of the Copper Falls. The lands are in two tracts, comprising the original Arnold mine, which was set off from the Copper Falls in 1863, and the Copper Falls mine, which was absorbed by the Arnold company in 1898. Lying between these two tracts is the Ashbed, which was set off from the Copper Falls at about the same time as the Arnold. The Arnold lands have a frontage of about three miles on Lake Superior, to the north, and are bounded on the east by the Eagle Harbor, on the south by the Dana, Central and Winthrop, and on the west by the Humboldt. The property lies north of the greenstone.

Chas. L. Davenport is president and John Brooks secretary of the Arnold company, with offices at 50 State street, Boston. The company is incorporated under the laws of Michigan, and has 100,000 shares, all issued. There were 583 shareholders of record on Dec. 31, 1899. Wesley Clark is superintendent, John Bennetts clerk, Charles Hartman mining captain, August Christman master mechanic and mill superintendent, Samuel Reckard wash boss, John Lanyon and William Batten shift bosses.

The old Copper Falls mine was opened in the late forties, and during its period of productivity, from about 1850 until August, 1893, when copper sold at 10 cents per pound and the mine was closed down, a grand total of 12,843 tons 429 pounds of ingot copper was produced. The mine was steadily worked for this period of over forty years, with the exception of 1879.

The Copper Falls was opened originally on fissures north of the greenstone, and the richness of the Owl Creek vein, from which the dividends of $100,000 paid by the mine were secured, seems the exception to the general rule that the fissure veins north of the greenstone are not profitable. The production of upwards of 12,000 tons places the Copper Falls among the really important copper mines of the district. The maximum product was achieved in 1867, when the output of ingot copper was 1,128 tons 1,485 pounds. The Owl Creek fissure eventually became poor, as happens with all of the fissure veins, and attention was turned to the ashbed. At times this was quite rich and high hopes were raised, to be succeeded by several years of depression. Considerable money was sunk in working this lode; the ashbed is decidedly a low-grade proposition and can be made to pay only when worked on a large scale. The Atlantic mine has earned

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its dividends from an ashbed apparently identical with that of the Copper Falls, and which is probably the western continuation of the same lode, judging from its relative position to the greenstone, and from the appearance and mineral content of the rock.

The Arnold proper lies west of the Ashbed mine. A little work was done in the years immediately following its setting off from the Copper Falls in 1863, but only a limited amount of cash was expended in the effort to develop a mine, and work was suspended about the close of the civil war, and not resumed until 1892, when a reorganization of the old corporation was secured, the charter being about to lapse. Some work was done in the two following years, but the low price of copper and the generally discouraging prospects of the mine and the copper industry brought about a suspension of all work. Efforts to develope the mine were resumed in 1897, under the local management of Capt. Clark, and the work was begun and carried through upon a considerable scale. It being evident that only large openings could feed the mill with sufficient rock to keep the stamps profitably supplied, a shaft was sunk for about 800 feet, and a second shaft started on the ashbed. The mine began producing in the fall of 1898 and made 76 tons 320 pounds that year. The percentage of ingot copper in the ashbed proved to be about the same as at other mines opened on that lode, running under 8/100 of one per cent, and the result proved very discouraging. It being seen that the only hope of the company was in securing a large production, the Copper Falls mine was absorbed by the Arnold company, an increase in the stock to the maximum capitalization allowed under the Michigan laws allowing the purchase of that mine for stock in the Arnold company. Work was continued at the Arnold property, and resumed on the ashbed workings of the Copper Falls lands. The product of refined copper for 1899 was 381 tons 1911 pounds.

The mill of the Arnold is on the Copper Falls location, and a narrow gauge railroad two and one-fourth miles in length connects the mine and mill. This also provides for the transportation of miners and other workmen from the village of Copper Falls, where there are ample accommodations for a considerable force, to the Arnold, where there are only a few dwellings. The railroad is known as the Arnold & Eagle Harbor, but at present does not extend north or east of Copper Falls. The equipment consists of one Baldwin locomotive and six rock cars of 25 tons capacity, also one flat car.

No. 1 shaft of the Arnold is about 1,000 feet in depth, and some sinking has been done in No. 2 shaft during 1899 and 1900. Mining is also in progress at the Copper Falls, which furnishes a part of the rock for the mill. The product for 1900 will show a fair gain over that of the preceding year. About 200 men are employed at present and the property gives evidence of economical and conscientious management on the part of Capt. Clark and his assistants. The dip of the shafts is very flat, running about 26 degrees, a little west of north.

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In addition to the ashbed, there are other amygdaloids carrying copper outcropping on the Arnold tracts, and a considerable number of fissure veins, several of which have proved productive south of the greenstone, but on which very little work has been done to the north of that belt.

At the stampmill there are two Leavitt heads, with the necessary complement of jigs and slime-tables. The Arnold copper is fine and requires careful dressing to save the minute particles. One stamp is run steadily and the second is worked at times, though mainly held in reserve for use in case of accident, or repairs being required by the first head. There is a Wilfley concentrating table, placed in the mill in the summer of 1900, and this is giving very satisfactory results, proving its ability to save a large amount of the very fine copper which has heretofore been lost with the slimes. Power for the mill is supplied by four horizontal boilers, and water is brought to the mill by gravity from dams on the high plateau above, thus saving the cost of pumping.

The Arnold met with a serious accident in August, 1899, which stopped production for some weeks, and entailed heavy costs for repairs. The old Owl Creek Mine of the Copper Falls was opened by adits and blind shafts. The dam above the single shaft opening to surface gave way, owing to the pressure from exceptionally heavy rains, allowing the water to fill the old mine openings. This water gushed from the old adits under heavy pressure, one stream nearly demolishing the office building, while the lower adit, which had a string of tram cars in its mouth, trained a stream of water some seven feet square against the boiler house of the mill, under a head of about 300 feet. The tram cars were thrown against the building with great violence, completely demolishing the structure and moving the boilers from their foundations. The Arnold also suffered considerable inconvenience in the late winter and early spring of 1900 by reason of shortage of coal, but an ample fuel supply has been laid in for the winter of 1900–1901, and a recurrence of this trouble fully guarded against.

The sworn statement made to the State of Michigan by the Arnold Mining Company on Dec. 31, 1899, gave the following figures:

Amount paid in on capital stock	$396,308.00
Amount paid in by conveyance of property	215,000.00
Amount invested in real estate	81,883.80
Amount of personal estate	244,000.00
Amount of floating indebtedness	13,227.70
Amount due corporation	26,799.11

ASHBED.

Work at this property was stopped in July, 1900. The official title of the corporation is the Ashbed Mining Company. The main office is at 50 State street, Boston, with Col. John Huhn president, and John Brooks secretary and treasurer. The company is incorporated under

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the laws of Michigan, and on Dec. 31, 1899, had 215 shareholders. Capt. Wesley Clark, of Copper Falls, is superintendent and John Bennetts clerk. The mine is located between the Arnold proper and the Copper Falls portion of the Arnold, with Lake Superior on the north and the lands of the Central mine on the south. The location comprises 1,143 acres of land, all on the mineral belt, north of the greenstone. The boundary lines on the eastern and western sides run somewhat west of north, in order to give a cross-section of the formation. The lands of the Ashbed, like those of the original Arnold mine, were owned by the Copper Falls company, and were set off in 1861, at the suggestion of Capt. Wm. Petherick, the agent of the Copper Falls company, and the property so set off was named the Petherick, in his honor. Mining was begun in the following year, on the ashbed, and the rock secured therefrom was stamped at the Copper Falls mill. Work was stopped in 1865, resumed in 1872, and again stopped in 1877. The third period of activity was in 1881 and 1882, when a few tons of copper were secured, and the fourth period was in 1898–1900, when only exploratory work was done. The Petherick company paid $30,000 for the lands secured from the Copper Falls company. In 1872 the stampmill of the Indiana mine, in the Bohemian district, was bought and installed at the Petherick mine. In 1874 the mine produced 5,115 tons of stamp rock, which yielded 167,976 pounds of mineral, which in turn gave 141,199 pounds of ingot copper, a percentage of 1.38 per cent ingot. The Petherick company failed in 1877, and the Ashbed Mining Company was organized in 1880 and purchased the property at receiver's sale. A somewhat elaborate plan of operations was prepared, but was not carried into full effect because of lack of funds, the total production of copper for 1881 and the following year amounting to a little less than 50 tons. The mine is credited with a total product of 391 tons 1,854 pounds of ingot copper.

The mine is opened by means of a tunnel and blind shafts. The sworn statement made to the State of Michigan on Dec. 31, 1899, gave the following items regarding the company's affairs:

Amount of cash paid in on the capital stock..	$ 3,000.00
Amount paid in by conveyance of property...	.....
Amount invested in real estate.....	20,000.00
Amount of personal estate.....	1,900.00
Amount of floating indebtedness.....	664.29
Amount due corporation	.....

The ashbed lode of the Arnold traverses the entire tract of the Ashbed Mining Company, from east to west, giving an outcrop of nearly a mile on the lands of this property. There are also a number of cupriferous fissure veins, having a strike approximately at right angles to the ashbed, with nearly vertical dip.

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HUMBOLDT.

Work at this mine was stopped July 31, 1900.

The official title of the corporation is the Humboldt Copper Company. The main office is at 50 State street, Boston, Mass. W. F. Fitzgerald is president and John Brooks secretary and treasurer. The company is incorporated under the laws of Michigan. The number of shareholders of record on Dec. 31, 1899, was 411. Wesley Clark is superintendent and John Bennetts clerk.

The mine is located about midway between the Arnold and Phœnix, and lies north of the greenstone. The company owns all of Sections 16 and 21, Town 58 North, Range 31 West, the former being a fractional section, owing to bordering on Lake Superior, giving a total of 1,163 acres of land, all located on the mineral belt. The property lies next west of the Arnold portion of the Arnold mine and has the Eagle River and Natick properties on the south and the Phœnix and Meadow on the west.

There has been a considerable amount of work done on the Humboldt from time to time, since first opened in 1853, but it has never been a producer. There is a single shaft, down over 300 feet on the ashbed, which here exhibits the same characteristics as at the Arnold and where opened elsewhere in the Arnold district, carrying a low percentage of stamp-rock at most points, with occasional bunches of very rich ground. There are four dwellings on the property, also an engine and compressor house, blacksmith shop, shafthouse and powder house. About $125,000 all told, has been expended on exploratory work between 1853 and 1900.

The sworn statement returned to the State of Michigan on Dec. 31, 1899, gave the following figures:

Amount of cash paid in on capital stock.....	$132,683.76
Amount paid in by conveyance of property..	100,000.00
Entire amount invested in real estate.....	94,831.80
Amount of personal estate.....	3,793.28
Amount of floating indebtedness.....	5,233.97
Amount due corporation.....	.....

MEADOW.

This property is owned by the Meadow Mining Company, with main office at 50 State street, Boston, Mass.; W. F. Fitzgerald president and John Brooks secretary and treasurer. Capt. Wesley Clark is agent and John Bennetts clerk. Thomas Morgan is mining captain, and eight men are employed at present. The property consists of a tract of 364 acres, north of the greenstone, in Sections 17 and 20, Town 58 North, Range 31 West, with Lake Superior on the north, the Humboldt on the east, and the Phœnix on the south and west. The first mining work at the property was done in the latter fifties, on a narrow fissure vein in which nothing of much promise was found. The present incorporation dates from 1898. There is a single shaft, on the ashbed,

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which crosses the Meadow property east and west, giving an outcrop of a trifle more than half a mile on the lands of the company. The lode is apparently of about the same value as at the Arnold and intervening properties, and presents the same characteristics.

The plant is well suited to exploratory work, consisting of a compressor, power drills, boiler and hoist, the surface machinery being housed under a single roof. The mine makes little water, which is easily handled by a single small pump. Some excellent rock has been secured from the mine from time to time.

Following is a summary of the principal items in the sworn statement made to the State of Michigan on Dec. 31, 1899:

Amount of cash paid in on capital stock.....	$37,500.00
Amount paid in by convepance of property...	37,500.00
Amount invested in real estate....	37.500.00
Amount of personal estate.....	6,136.33
Amount due corporation.....	.....

PHOENIX.

The Phœnix Consolidated Copper Company was organized in the spring of 1899, under the laws of New Jersey, with 100,000 shares of the par value of $25 each. John R. Stanton is president and J. Wheeler Hardley secretary and treasurer, with eastern offices at 11-13 William Street, New York City. Frank McM. Stanton is agent, Dunbar D. Scott superintendent, John F. Robert clerk, Edward Hall mining captain and Chas. H. Wilkings master mechanic. Superintendent Scott acts as mining engineer. Number of shareholders, on Dec. 31, 1899, was 352.

The property consists of 2,505 acres, and comprises the old Phœnix, St. Clair and Garden City properties, and 80 acres of the old Atlas property, which latter tract was purchased in the summer of 1900. Lake Superior lies on the north; the Meadow, Humboldt and Eagle River properties on the east; the Atlas and Union on the south, and the Cliff on the west.

The present Phœnix Consolidated Company is the lineal successor of the Lake Superior Copper Company, the first regularly organized corporation to engage in Lake Superior copper mining. The Pittsburg & Boston company begun actual mining on the Cliff property a few months before the Lake Superior company did its first work, but was organized later. The Lake Superior company located 21 square miles under permits from the War Department, and actual mining was begun Oct. 22, 1844, on a fissure vein outcropping on the east bank of the Eagle River, on the line between Sections 19 and 30, 58-31, and very near the ashbed. The miners left on the property, fifteen in number, nearly starved during the winter of 1844-45, owing to the wrecking of the brig sent them with supplies; but thanks to the game secured by shot and traps, pulled through till spring, though so much time was

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required to find food and fuel that little mining was done. A stamp-mill was built in 1845, this being the first in the district, but proved a failure, being badly adapted to the requirements of the rock milled, and the poor results secured from this pioneer plant were largely responsible for the early prejudice against stamp lodes and stamp mills. The first fissure proved pockety and was soon exhausted. In searching for its continuation, a fissure was found beneath the bed of the river, from which nine tons of mass and barrel copper were secured, and considerable silver as well, one piece weighing 8¾ pounds being taken from beneath the stream. It is now in possession of the mint at Philadelphia, and remains one of the largest pieces of native silver ever found, in the Lake copper district or elsewhere. The early work was done under the superintendence of the late Columbus C. Douglass. In 1847 the Lake Superior company had expended $98,790.50 and the shareholders were tired. In 1849 a reorganization was effected, and the Phœnix Copper Company took over the assets of the original corporation. Five different fissures were opened, these being known as the Phœnix, East Phœnix, Armstrong, Ward and Robbins. The last-named was south of the greenstone, the other four north of that bluff, and all located in Section 19.

In the late fall of 1850 mining was resumed with Simon Mandelbaum as agent. In 1851 attention was transferred from the newer workings to the original vein under the bed of Eagle River, but it proved too narrow to be worked at a profit, though quite rich in both copper and silver.

From the time it was opened, in 1844, until closed in 1886, the history of the Phœnix is one of bright hopes, considerable production, vacillating policies, and many assessments. Work was undertaken at nearly a score of points in all, but steady effort at any one point was rarely continued for more than a few years. From all of these openings more or less copper was secured, the total production of the mine amounting to the very respectable figure of 7,773 tons 39 pounds of refined copper; the largest annual output having been secured in 1874, when the production was 699 tons 400 pounds. There is probably no copper property in Michigan where there are so many shafts and adits, but most of them are shallow or short, and there seems to have been no fixed policy pursued, except for the few years that the property was in charge of Frank G. White as agent, and W. E. Parnall as mining captain, during which period the Phœnix made money, for the first and only time in its history.

The old stampmill was rebuilt in 1855 and again in 1858, being run first with water power from Eagle River, and later with steam power, there being at one time 48 gravity stamps in use. Three years' steady mining was done on the ashbed, but the maximum product therefrom was under forty tons annually. In 1863 mining was started on the Phœnix and Robbins fissures, just south of the greenstone. From like fissures bearing a similar relation to the greenstone the Cliff and Cen-

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tral mines were making fine profits at that time. The Phœnix vein promised well on surface, but at a depth of 200 feet pinched so that there was no profit; widening again at greater depth and becoming highly productive, one mass being found which is estimated to have yielded nearly 600 tons of copper; but so inefficient were the people in control of the mine at that time that little if any profit was made from this magnificent mass. A management that could not make a profit from six hundred tons of virgin copper worth about 30 cents a pound can scarcely be called anything but utterly stupid. In 1871 the Bay State property was purchased by the Phœnix and in 1872 Frank G. White was made agent. In 1873 Capt. W. E. Parnall was made mining captain and for the next four years the Phœnix prospered. In 1874 the mine netted $24,000; and in 1875 a net profit of $55,000 was secured, in addition to expending $20,000 in opening the Robbins vein and making extensive surface improvements. In 1876 the net profit, after providing for all operating expenses and doing a considerable amount of development and construction work, was $107,186. It was in this year that the Phœnix paid its first and only dividend, amounting to $20,000. In the following year Capt. Parnall resigned, and the period of prosperity of the mine, which was coterminous with his connection with the property, came to an end. The old troubles with pinching veins, changing policies and general vacillation, were again encountered. About $200,000 in all was expended on the Robbins vein, which unlike the majority of fissures does not cross the formation at approximately right angles. In 1878 the last dollar of the surplus accumulated during the preceding four years disappeared, and assessments again became the order of the day. In 1883 the company, which had been several times reorganized, became hopelessly involved and stopped work, after expending $837,500 secured from the many assessments levied. The property was worked on tribute for three years thereafter by M. A. Delano, the agent who succeeded Mr. White, but he gave up the struggle in 1886, since which the old Phœnix has been idle. For the fourteen years from 1872 to 1885, inclusive, the yield of refined copper from the Phœnix was 473 pounds per fathom stoped, or approximately one and one-third per cent ingot—about the recent average of the Wolverine, Osceola and Quincy mines. The return per fathom of ground last year in the Quincy was 427 pounds ingot por fathom broken, while the average in the Phœnix for the fourteen years mentioned was 396 pounds per fathom broken, the figures running as low as 243 pounds per fathom in 1879 and as high as 749 pounds per fathom broken in 1874.

In addition to the Phœnix proper, the Phœnix Consolidated includes the Garden City and St. Clair mines. The Garden City was opened in 1859 and closed in 1868, after producing a total of 37 tons 1397 pounds of ingot copper. The St. Clair was opened in 1865 and closed in 1874; reopened in 1880 and again closed in 1885. In the latter period of activity the capital was furnished by local people—who lost their

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money. The total production of ingot copper by the St. Clair, previous to its purchase by the present owners, was 505 tons 1,071 pounds.

The following figures regarding the Phœnix Consolidated are from the official sworn statement returned to the State of Michigan on Dec. 31, 1899:

Amount paid in on capital stock in cash.....	$300,000.00
Amount paid in by conveyance of property..	500,000.00
Amount invested in real estate.....	500,000.00
Amount of personal estate	245,517.36
Amount due corporation	5,475.36

As before stated, about a score of copper-bearing fissures have been opened in the past sixty years, most of which are little developed and presumably of small importance. The ashbed amygdaloid has been mined on quite extensively in the past and an unidentified amygdaloid, 45 feet wide and carrying copper, has been cut by the crosscut now being sent due south from the St. Clair mine. This is a drift on the fissure, but a crosscut so far as concerns the formation. The crosscut is now about 400 feet south of the shaft, and is from the fourth level, about 400 feet below surface, and approximately a quarter of a mile south of the greenstone. This amygdaloid lies about 60 feet south of the shaft and attention will be paid to it later. At present it is intended to crosscut south to the presumed locality of the Calumet conglomerate; but whether this latter will be found where supposedly located is doubtful. The formation at the Phœnix differs from the stratification to the east and west. The Allouez conglomerate underlies the greenstone at the Allouez mine on the east, and again at the Delaware on the west, but is entirely missing at the Phœnix. Other amygdaloids and conglomerates found to the east and west are also missing here. Little dependence can be placed on findings made elsewhere, and the present management is virtually proving an uncharted territory, on which nothing has been done heretofore, in going south of the old workings. Some test-pitting was done by Samuel W. Hill some thirty years ago, but the results were too meager to use as a basis for positive opinions of any sort. The present crosscut from the St. Clair is sufficiently deep to be entirely below any disorganization of the strata due to effects of the elements, and will test the country traversed very thoroughly.

The ashbed, where opened, is 5 to 25 feet in width. Work was done on this lode, up to the summer of 1900, when mining ceased on account of bad air, but will be taken up again when opportunity offers. The ashbed is being opened by an adit running from the bank of Eagle River toward the Garden City property, and which is opened in the lode for its entire extent, a distance of about 400 feet. In the fall of 1899 a bunch of very rich stamprock was encoun-

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tered on the ashbed, from which about 500 tons were mined and stocked, pending the building of a mill. The ashbed displays the characteristics noted to the eastward, being irregular in width and mineral content, ranging from very rich to very poor. Where work was stopped, the lode was badly cramped, being only 5 or 6 feet wide, but will unquestionably widen again at a little distance, as it is one of the most persistent amygdaloid lodes of the district. There is some slight possibility that this may not be the true ashbed, though it is probably such.

At present no work is being done on the Phœnix mine proper, though it is intended to unwater and test the old workings, probably early next season. There are two shafts on this part of the mine, known as the Tyler and Crocker shafts. The vertical Tyler is only 300 feet deep, but the Crocker shaft has a depth of 780 feet, and is also vertical. An incline shaft running from the Tyler shafthouse on the angle of the formation was also sunk to a depth equivalent to exactly 1,000 feet of vertical depth, this shaft nearly paralleling the false slide under the greenstone.

The present management has confined mining to the old St. Clair property, and is arranging to resume mining on the Robbins, or West Vein of the old Phœnix, the mine on which has just been unwatered, at the present writing, Oct. 29, 1900. The St. Clair fissure is narrow but rich, averaging 18 to 24 inches in width and carrying 2 or 3 per cent in copper. It has a strike of about 15 degrees west of north, and a dip of about 84 degrees with the horizon, to the east. There is a single shaft, sunk on the sinuosities of the vein to a depth of about 400 feet, 8 x 10 feet inside of timbers, with one compartment for hoisting, and a ladder and pipeway. This may be enlarged to three-compartment size later, to give room for two cages. Six levels are opened. The present management found a plat cut out for the sixth level and has drifted on that level and is now sinking for the seventh level, which has nearly been reached. A little stoping has been done and a stock-pile of about 5,000 tons of excellent stamp-rock has been secured; in addition to which about 60 tons of mass and barrel copper have been sent to the smelter, a five-ton mass of copper having been cut up in the sixth level early in October. The plan of operating the mine is somewhat unusual. The nearly vertical shaft is about 400 feet deep. From the bottom, on the fourth level a drift runs 700 feet north, to the "false slide;" from that point an incline leads down the "false slide" at an angle of 45 degrees, drifts being run north from this slide at vertical depths of 100 feet as far as the "true slide", which underlies the greenstone at an angle of 27 degrees. Some of the rock stoped has come from the old levels above the fourth, between the shaft and the greenstone. The management figures that the metal from the St. Clair will come about one-third in mass and barrel work and about two-thirds in stamp copper, the past history of the mine warranting this supposition.

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The old Phœnix fissure averaged 3 to 6 feet in width, with a strike 5 degrees west of north, and nearly vertical dip.

At the Robbins, or West Vein, now unwatered, the fissure averages 3 to 4 feet in width, occasionally running as wide as 6 feet.

Previous owners under various managements have expended upwards of $200,000 on the Robbins fissure. There is something uncanny about it; it runs east of north, conforming neither to the trend of the amygdaloid and conglomerate strata of the regular formation, nor to the fissure veins, which nearly always run at approximately right angles to the formation. It cannot be a contact vein, and must therefore be termed a fissure, though of a most unusual variety. There is a possibility that it may prove to be a feeder to some other fissure, in which case the junction point would in all likelihood prove rich in copper, with good chances of finding the main fissure unusually strong. The dip of the Robbins is nearly vertical. It has not proved a rich vein when worked in the past. It is the intention of the present management to prove the formation in that district, by means of crosscuts, or otherwise, as appearances and developments may indicate to be most feasible.

The present management is reopening the property with great economy. A large amount of old machinery was on the ground, and a considerable number of old structures, including three stampmills, afforded good building material. All of the old buildings capable of further usefulness have been conserved, and a number of them rebuilt. Boilers and a hoist have been secured from the old St. Clair mill; an air compressor and timber from the old Phœnix mill, and pumps from the old Phœnix mine. About the only new machinery bought has been the power drills and a No. 7 Cameron pump. There are three mine pumps, these being the new Cameron referred to, a large duplex Worthington, and a medium size Prescott. The mine is very dry, the St. Clair not furnishing enough water for the boilers on surface. Wherever new construction has been undertaken the buildings have been made of a permanent nature, with ample room for the installation of additional machinery for operating on a considerable scale; but the present outfit does very well for exploratory and development uses. The St. Clair is showing marked improvement with depth, and should this continue, an additional shaft will be required before the mine begins production upon any considerable scale. The new shaft —if sunk, as now seems probable—will be so planned as to obviate the somewhat tortuous route of opening now followed in the St. Clair mine.

At the Robbins there is one horizontal boiler and one hoist of the vertical type, sufficient for present needs, but liable to require replacing with more powerful machinery if much work is done on the West Vein. A compressor will be placed there later, if any great amount of drilling is required.

A good machine shop has been fitted up in the old Phœnix mill,

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containing a boiler and shop engine, two good lathes, planer and shaper, drill press, radial drill, bandsaw, emery wheel, grindstone, etc., ample for the probable requirements of the mine for some time to come, and with room for additional machinery when required. There are a number of dwellings, many of which have been repaired and are in use, while a dozen or so more will be rendered habitable before winter. The mining location is an exceptionally fine one, and between the greenstone bluff, the rapidly rushing Eagle River, and the neat dwellings, is one of the most picturesque in the district. There is a good warehouse, a new barn, and all other things needful for economical development work.

There are two air compressors, one of four and one of ten-drill capacity, at the St. Clair shaft. There are six power drills, and these are notable for their diminutive size, being "baby" drills, using ⅞-inch steel and weighing only 100 pounds each, without their weights. They are probably the only drills of this size in use at any Lake Superior mine of copper or iron, and were chosen for their portability and the ease with which they can be worked in small openings. The fissures on the Phœnix are narrow, and in the old days of hammer-and-drill it was necessary oftentimes to break two fathoms of country rock for one of vein-matter. The "baby" drills work nicely in a four-foot stope, thus obviating the necessity of breaking much unproductive rock.

There are three old stampmills on the lands of the company, and there remain the foundations of yet others of even more archaic type, built in the days of long ago. These will all be torn down, the timber utilized for other construction, and the shafting, pulleys and other usable parts placed elsewhere, but the old stamps, jigs and slime-tables will go to the furnace as scrap-iron. The company is already figuring on a modern mill, and is giving careful thought to the two plans which suggest themselves. One of these is to build a mill on the Eagle River, which is one of the largest streams in Keweenaw county, and can be depended on for a good supply of water at all seasons of the year. Such a mill would be located on the company's lands, near the site of the old Phœnix. Figures are now being obtained on an ærial tramway, such as is in general use in western mines, though never given trial in the Lake district. There is a considerable down-grade from the St. Clair mine to the millsite, and it would be possible to run the system by gravity alone, with a single man, something no tram-road on surface could possibly do. The loaded buckets would pull the empty ones back to the mine, and a couple of turns of the cable around a drum at the shafthouse would give the man at the headsheave a chance to operate the entire system by means of a friction clutch, no power of any sort being required beyond the very moderate strength of arm needed in applying the friction belt or clutch.

In case the mill is located at the old Phœnix, a single stamp will

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be installed at the start, though water for another stamp could probably be had, and could certainly be easily secured if a dam were to be built to impound the water of the river. There is a fall of nearly or quite 150 feet from the river at the St. Clair, to the old Phœnix millsite, and a steel flume of 12 to 15 inches diameter could carry water and deliver it at the mill with a head of 140 to 150 feet, which would give ample power to operate impulse compressors and perhaps furnish power for the mill; after which the waste-water could be used for wash-water in dressing the rock after stamping.

The second contingency being figured on at present is the building of a mill on Traverse Bay, Lake Superior. To do this it would be necessary to build about four or five miles of railroad to connect with the Traverse Bay & Mohawk railroad, a little detour from a direct route being called for by the high plateau lying about two miles south of the Phœnix. The Mineral Range Railroad is at present only about four miles south of the Phœnix, though passenger trains are not run north of Calumet.

To one who has watched the expenditure of fortunes on surface work before a mine has been opened underground, the plan of operations being followed in the rehabilitation of the Phœnix is a grateful change. The money is going underground, and not on surface. Although a cash working fund of $300,000 was placed in the treasury after title was secured to the various properties in the consolidation, the existence of a large amount of ready money has not been allowed to breed extravagance. Wherever possible old buildings and old machinery have been utilized, and where such a course was inadvisable, good modern machinery has been bought, or permanent buildings have been erected. The Phœnix Consolidated is under the Stanton management, which seems to make a specialty of taking old properties that have been unusually flat failures, and making them over into dividend-payers, as in the case of the Atlantic and Wolverine; or in opening mines where other people had spent large sums to satisfy themselves that no mine existed, as in the case of the Mohawk. At the various mines in the Phœnix consolidation much more than a million dollars have been lost by previous owners, but despite the record of repeated failures, the properties have always been regarded favorably by mining men. They are now being given a fair trial, for the first time in their history, and their present prospects are good.

MOHAWK.

The Mohawk Mining Company was incorporated under the laws of Michigan, in November, 1898. It is capitalized at $2,500,000, with 100,000 shares of the par value of $25 each, all stock issued. The number of shareholders on Dec. 31, 1899, was 594.

Officers of the Mohawk company are John Stanton, president; John R. Stanton, secretary and treasurer; John Stanton, Jos. E. Gay, John R. Stanton, Wm. A. Paine and Fred Smith, of Michigan, directors.

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The registrar of the stock is the Boston Safe Deposit & Trust Company, of 87 Milk street, Boston; and the American Loan & Trust Company, of Boston, is transfer agent. Annual meetings of the corporation are held on the last Tuesday in March of each year. The eastern office of the company is at 11-13 William street, New York City.

Fred Smith is agent of the mine, Frank Getchell clerk, Willard Smith, mining engineer, and Henry Trevarrow mining captain.

The Mohawk is one of the few really new mines of the district, many of the other new corporations of the past two or three years having merely resumed work at old properties. The Mohawk is a new mine, from the grass roots down. The property was known for many years as the Fulton, and was generally supposed to lie too far east to carry the outcrop of the Kearsarge lode. The Ahmeek property, lying next west of the Mohawk, was explored for the outcrop of the Kearsarge, without success. The finding of the outcrop of this amygdaloid bed on the Mohawk property renders it apparent that there is a much greater deflection of the formation to the eastward, in making north, than has been supposed. The explorations at the Ahmeek were carried on in a line with the lode produced from the Kearsarge and Wolverine openings. The lode was discovered accidentally on the Mohawk property by the cutting of a wood-road, some five years ago. Explorations were conducted quietly by Mr. Joseph E. Gay, and when it became apparent that the find was of great importance, the Mohawk company was organized. The shares were placed on the market at $7.50 each, and so eager was the demand for them that many subscribers were unable to obtain shares, and the allotments of others were greatly reduced. The first sales of the stock on the curb, after the organization of the company, were at $15, and the Mohawk is one of two or three out of the thirty new mining companies of the district which has not seen its shares drop below subscription price during the period of depression following the great copper boom which culminated in the spring of 1899.

The Mohawk company owns a tract of 800 acres of land, of quite irregular contour, in Sections 27, 28, 33 and 34, Town 57 North, Range 32 West. The axis of the tract is on the trend of the formation, giving the maximum of easily accessible mineral ground for the area of the property. The outcrop of the Kearsarge lode extends for almost exactly one mile on the Mohawk lands, while at the greatest width of the underlay the length of lode possessed is fully one and a half miles.

The Mohawk is in Keweenaw county, four miles northeast of the Calumet & Hecla, and has for neighbors the Ahmeek and Seneca on the north, the Bacon & Jacob tract on the east and south, and the Ahmeek on the west. The southwestern boundary of the Mohawk is a trifle more than one-half mile from the northern boundary of the Kearsarge mine of the Osceola Consolidated, and the southernmost shaft is about two miles northeast of the northernmost shaft of the Wolverine, opened on the same lode.

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The company was organized with $300,000 cash in the treasury, after paying $450,000 for the mineral lands and for the millsite and railroad secured from Hebard & Son. An assessment of $2.50 per share was levied in June, 1900, giving a total of $550,000 cash for the development and equipment of the mine, extension of the railroad, and construction and equipment of a stampmill. In the first two years of corporate existence the company has expended probably more than $300,000 in cash, but the showing secured for this expenditure takes the Mohawk out of the rank of prospects and places it among the mines of the district.

From the sworn statement returned to the State of Michigan on Dec. 31, 1899, the following figures are secured:

Amount of cash paid in on the capital stock	$300,000.00
Amount paid in by conveyance of property	450,000.00
Amount invested in real estate	451,236.17
Amount of personal estate	136,205.14
Amount of floating debt	12,639.17
Amount due the corporation	.....

From the annual report issued to shareholders, it is shown that on Dec. 31, 1899, the company had a surplus of $123,575.97 and had expended $178,707.76, of which amount $168,026,26 had been spent at the mine and the balance for railroad surveys, franchise tax paid on incorporation, United States stamp tax, registration of the stock and listing of shares on the Boston stock exchange, and for salaries and general expenses. The floating debt was for current liabilities, incurred but not due, at the mine. Of the expenditures at the mine, $57,192.91 was spent underground; $27.995.58 on surface labor and miscellaneous surface work, and $80,574.78 was laid out in construction account at the mine, this last item covering machinery, building material and labor on the same. There was also an item of $3,137.40 for various expenditures on the railroad line.

While the Mohawk property may and probably does carry other cupriferous lodes, no attempt has been made to locate them, all effort and expenditure being confined to the development of a paying mine, at the earliest possible moment, on the Kearsarge amygdaloid. When the mine is paying dividends it will be time to consider the matter of explorations on the extensive tract owned by the company. Work has been done on a fissure vein, but as this was cut in opening on the amygdaloid, it cannot be considered as separate exploratory work. Almost any management would follow a fissure carrying values of $150 to $250 per ton.

There are three main shafts on the property, which are already down to considerable depths. They are numbered from north to south. The northernmost, No. 1, is located about 1500 feet southwest of the point where the outcrop of the lode passes over the northeastern

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boundary of the property. This shaft is about 600 feet deep. No. 2 shaft is 1100 feet southwest of No. 1 and of a little greater depth. No. 3 is 1100 feet southwest of No. 2, and of considerably less depth. No. 4 was started in the summer of 1900, and is but a short distance south of No. 3. Shafts 1, 2 and 3 are each of three-compartment size, having two skiproads and a separate pipe and ladderway, and are 8 x 18 feet inside measurement. They are solidly timbered through the overburden and are handsome specimens of shaft sinking. There are permanent shafthouses at each, so constructed that rockhouses can be added thereto whenever the mine is ready to begin production. Considerable stockpiles of fine stamp rock have been accumulated at each shaft, through the opening work underground, and these stockpiles are decidedly rich in copper at all three shafts. Drifting on several levels is now under way at all three shafts, and the various shafts will be connected underground during 1901. The shafts are furnished with hoists good for a quarter mile each, and could handle rock from even greater depth at a pinch.

Careful examination of the rock shown on surface, and the appearance of the underground openings, lead to the conclusion that the Mohawk is at least as rich as the Wolverine or Kearsarge, and probably a little richer. No. 1 shaft has passed through especially fine ground from the ledge down to its present bottom, while Nos. 2 and 3 are fully up to the average of the Wolverine. Some poor ground has been met with south of No. 3, and as at present opened the northern end of the mine is the richer. This may change at greater depth, as the lode is variable and poor ground may turn into rich, or vice versa. A number of test pits were bottomed in the lode during 1898, and eleven of the thirteen so sunk struck in rich stamp-rock—an unusually high average.

In No. 1 shaft a fissure vein of copper ore was cut early in 1900. This proved to be an entirely new mineral, never before found, and was named "mohawkite" by Dr. Geo. A. Koenig, of the Michigan College of Mines, to whom specimens were submitted for analysis. The ore proved to be the double arsenide of copper and nickel, carrying about two per cent of cobalt and traces of iron. The mineral is a close relative of the domeykite and whitneyite ores found at the Shelden & Columbian mine, in Houghton, these latter being arsenides of copper. The fissure carrying the mohawkite crosses the formation at about right angles and is of nearly vertical dip. It varies in width from one to three feet, having an average width of perhaps 15 to 18 inches. The find was regarded at first with merely academic interest, but after the analysis gave returns of 62 per cent copper and 7 per cent nickel, the latter being worth twice the market value of copper, rendering the mineral content of the mohawkite equivalent to about 75 per cent of copper in market value, the fissure vein took on commercial importance. Per running foot of ground, a twelve-inch seam of mohawkite carries about 50 per cent more value than a running foot of the Calumet & Hecla conglomerate, with its average width of 12 to 15 feet. A cargo

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of 50 tons of the mineral was mined and shipped to New Jersey for refining during June. The fissure has been followed laterally and vertically. It has widened and pinched at various points, but still retains its existence. The management of the mine, being conservative, is not banking on the value of the vein of copper and nickel ore, for fissures are notoriously unreliable, but on the other hand, should the vein hold out to considerable depth and prove of fair length, it would be immensely profitable. It is easily mined, and being of such radically different color and composition from the matrice of trap, amygdaloid and conglomerate strata, is readily followed and cannot well be lost so long as it holds out. The mineral has an irregular fracture of silvery gray lustre when freshly broken, turning to a dirty green after continued exposure to the air, and greatly resembles whitneyite in its general characteristics and appearance. A small feeder of whitneyite leading into the main seam of mohawkite was found during June, 1900.

In the way of equipment, the management has proceeded from the start on the theory that the Mohawk was a mine and not merely an exploration, and has put up permanent buildings and placed mainly permanent machinery therein. A considerable number of comfortable dwellings have been constructed for the housing of employees and the usual mine buildings erected. Among the more important of the latter are the machine shop, blacksmith shop, carpenter shop and warehouse, the latter containing the mine office at one end, these buildings being 30 x 60 feet in size each. There are also two good barns, a dispensary for the mine physician, oil and powder houses, etc. The machine shop is well supplied with tools, and the blacksmith shop has a full complement of forges, grindstones, etc. At No. 1 shaft a combination engine-house and boiler-house is in use, and at the other two shafts there are separate engine and boiler houses. There is a 25-drill air compressor at No. 3 shaft, and an 8-drill compressor at No. 2 shaft, both of the Ingersoll-Sergeant make, and 12 Rand drills for underground use.

A dam has been built to supply water required for the boilers. The Mohawk is located pretty nearly on the backbone of the Keweenaw peninsula, hence there are no considerable streams available for water supply. The Mineral Range railroad has been extended to the mine, and delivers fuel and supplies at the Calumet freight rates.

The Mohawk has a millsite of about 140 acres, with a frontage of three-quarters of a mile on Traverse Bay, Lake Superior, in Section 35, Town 56 North, Range 31 West. A railroad seven miles in length runs from this site in a fairly direct line toward the mine, terminating at the old Hebard stone quarry in Section 6, 56–31. The quarry is about three and a half miles from the mine, in a direct line, but in order to secure easy grades it has been necessary to make a detour in building the connecting link, making the new section of road between the mine and quarry about six miles in length. A force of 150 to 200 men was employed during the fall of 1900 in grading this extension, and the line is nearly complete, at this writing, Oct. 31, 1900.

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It is intended to begin work early in the season of 1901 on the stampmill at Traverse Bay, which would allow ample time for its completion and equipment by the spring of 1902. The assessment of $2.50 per share levied in June, 1900, may and may not furnish sufficient funds for development work at the mine and the completion of the mill. In case the treasury runs short another asssessment will be levied. The showing at the Mohawk is such that the opening of the mine will not be permitted to suffer from lack of funds. I have no hesitation in stating that the Mohawk will become one of the great mines of the district, and will soon enter the ranks of the dividend-payers. I do not look upon it as a prospect, but as a developed mine. Ordinarily such an opinion regarding a mine opened less than two years, and having its first ton of copper to produce from stamp-rock, would be a somewhat hazardous prediction; but the case of the Mohawk is out of the ordinary. Any schoolboy can readily figure the area of a parallelogram if given the length of two of its sides lying at right angles, and it is almost as simple a matter to determine the value of the Mohawk. For a distance of one mile the outcrop of the lode has been tested and found above the average in richness. A short distance southward the same lode has been opened to a depth of 2,400 feet in the Kearsarge mine. These developments give the two sides of the parallelogram. The Kearsarge lode is apparently richer in the Mohawk than in either the Wolverine or Kearsarge mines, and both of those properties are money makers. They are not only getting a large return of copper per ton of rock stamped, but are producing copper very cheaply. The Mohawk has an experienced and thoroughly capable management. Under these circumstances it is not surprising that the future of the mine is not considered open to doubt by the most experienced mining men and investors of the copper district.

WOLVERINE.

Owned by the Wolverine Copper Mining Company, eastern offices at 11-13 William street, New York City. Officers are John Stanton, president; John R. Stanton, secretary and treasurer; John Stanton, John R. Stanton, Joseph E. Gay, J. Wheeler Hardley and Samuel L. Smith of Michigan, directors. The American Loan & Trust Company, of 53 State street, Boston, is transfer agent. The annual meeting of shareholders is held on the first Monday in August of each year. The number of shareholders of record on Dec. 31, 1899, was 892.

Local officers of the company are Fred Smith, agent; Chas. L. Noetzel, clerk; William Pollard, mining captain, succeeding Richard Nicholas, who resigned on account of ill health on April 1, 1900; Willard Smith, mining engineer; Barney Shearer, master mechanic.

The mineral lands consist of a tract of 280 acres on the copper belt, upwards of 200 acres of which carries the Kearsarge amygdaloid lode, on which the mine is opened. The Calumet conglomerate crosses the northwest corner of the property, but there is so little of it on Wol-

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verine lands that it would not be worth developing there, unless found very rich, which is probably not the case. The Osceola amygdaloid crosses the northwestern portion of the Wolverine tract, underlying about 50 acres only, and no attempt has been made to develop or even explore it at that point. The mineral bodies of the Mayflower underlie the Wolverine tract. No effort has ever been made to open any other cupriferous bed than the one on which the mine is developed.

For neighbors the Wolverine has the Kearsarge on the north, Mayflower on the east, Mayflower and South Kearsarge on the south, and Centennial on the west. The southern mine openings of the Wolverine are about one and a half miles northeast of No. 5 Calumet, the northernmost shaft of the Calumet & Hecla.

The Wolverine was opened in 1882 by local men, and some remarkably rich chutes of copper-bearing ground raised the expectations of the owners to a very high pitch. Lack of capital and lack of sufficient openings underground to allow a proper selection of rock brought about the failure of the company, after something less than 1,000 tons of refined copper had been produced. In 1889 a reorganization was effected, under the present title, and the capital stock was increased to 60,000 shares, at which figure it still remains. Work was resumed in the fall of 1890, when new machinery was secured. The direction of the reorganized corporation was placed in the hands of Messrs. John Stanton and Joseph E. Gay, of New York, men of large experience and successful records in copper mining. The reorganization of the property was brought about during a period of low prices for the metal and general depression in the copper industry. Cash was coaxed from the pockets of shareholders with difficulty, and the previous failure of the mine rendered investors dubious of its future. Every dollar that could be raised was expended underground, after the necessary tools and supplies for surface work had been secured. A shortage of funds for necessary work was met by Mr. John Stanton with cash advanced from his own pocket. In 1892 the mill, which contained a single stamp, capable of crushing about 200 tons daily, was started, considerable openings having been made underground. The rock was carefully selected from the better stopes and the mine began making a little money from actual production with the first day the mill was run. In 1892 the production of refined copper was 250 tons, in 1893 twice as much. The panic of 1893 and the following years of 9-cent copper and general business depression gave the mines of this district a severer test than ever before accorded them, yet the Wolverine survived the ordeal, despite its small size, its lack of a surplus fund and its previous ill success. The production of the mine under the present management has been as follows, the figures plainly showing the rapid growth of the mine from liliputian size to its present rank among the forty largest copper mines of the world:

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Year.	Product—Pounds Ingot.
1892	500,074
1893	1,025,062
1894	1,665,255
1895	1,815,391
1896	2,196,791
1897	2,316,296
1898	4,588,114
1899	4,500,373

The original holdings of the Wolverine were of very limited area, and as soon as the mine had a little surplus cash, the money was invested in adjoining lands carrying the underlay of the Kearsarge lode. Two additional tracts have been bought and added to the original property. These lands, bought only four and five years ago, would now command several times the prices then paid for them. Their acquisition assures the life of the mine to a period so remote that the present generation need not worry about the future, and, if necessary, additional tracts to the west which carry the underlay can probably be bought quite reasonably, as the Kearsarge lode thereon lies so deep that it could be opened from surface only at great expense. To the north and south the expansion of the Wolverine is cut off by the Kearsarge and South Kearsarge branches of the Osceola Consolidated; but with a property a full half mile wide and carrying a profitable lode under about 225 acres of land, the Wolverine can grow to several times its present productive capacity without becoming cramped for elbow room. The Franklin has been mining for over forty years from a tract of ground mineralized only under 84 acres, and still has several years of life in that contracted area.

From the official sworn statement returned to the State of Michigan on Dec. 31, 1899, the following items are taken regarding the affairs of the Wolverine:

Amount of cash paid in on capital stock	$230,000.00
Amount paid in by conveyance of property	550,000.00
Amount invested in real estate	715,665.23
Amount of personal estate	312,046.88
Amount of floating debt	34,357.43
Amount due corporation	115,094.66

The statement of the company, of date June 30, 1900, shows cash assets of $268,513.59, in addition to which there was the credit item of copper bills amounting to $126,091.73, practically the same as cash, giving a total of $394,605.31: also cash, fuel and supplies at the mine amounting to $35,252.89, making a grand total of $429,858.21 in cash and quick assets. To offset this there were liabilities of only $45,251.15, leaving a balance of quick assets of $384,607.06. In the foregoing

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statement no account is taken of the value of the mine, machinery and buildings.

On the reorganization of the mine, $10 per share was paid in on the capital stock of 60,000 shares, of which $50,000 was in cash and $550,000 consisted of the property, as turned over to the new corporation. Since the organization of the present company, $3 per share in assessments has been called, making a total of $230,000 in cash paid in by shareholders. To offset this amount, dividends of $510,000 have been paid to Oct. 1, 1900, the first dividend having been paid Oct. 1, 1898. By years the dividend payments of the Wolverine have been as follows:

Year	Dividends.
1898	$ 60,000
1899	210,000
1900	240,000

The Wolverine held sixth place as a producer and fifth place as a dividend-payer among Lake Superior copper mines in 1899. The Wolverine dividends for 1899 were of exactly the same amount as the total dividends paid by all Lake Superior copper mines in the two years of 1867 and 1868—the two years preceding the payment of the first dividend from the Calumet conglomerate.

In the year ending June 30, 1900, the Wolverine sunk 394½ feet; drifted 5,707 feet and stoped 10,561 fathoms of ground. The cost of sinking averaged $17.04 per foot; drifting averaged $7.09 per foot, and stoping cost $9.34 per fathom. Underground expenses amounted to $207,157.55 net; rock house expenses were $17,409.26, and stamp mill expenses were $76,037.24, with surface and incidental costs of $28,832.83; against which there was a credit of $1,927.75 for rents received from the company's tenants. Construction account for the year aggregated $67,688.54 of which $24,510.08 went into No. 3 engine house and the machinery therein, the balance of construction account going for 22 new dwellings for employees, including a handsome residence for the agent, and a new house for the mine physician, in which is incorporated a dispensary. The other 20 dwellings cost $29,403.26, an average of nearly $1,500 each. There is probably no mining field in the world where the employees of the mines are so well housed as in the Lake Superior copper district; and the Wolverine affords its miners accommodations equal to the best. It is the theory of the management, that good workmen are the cheapest, and good men require good accommodations. A trip through the Wolverine or some similar mining location in Houghton county will show many miners' homes of neat design, excellently built, well painted. There are lace curtains at the windows, the rooms are carpeted, often with Brussels or other costly fabrics, and pianos are numerous. Where the piano is lacking, an organ will be found in at least half the houses. A personal visit to

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the mines and mining locations, with a view of the miners and their families, their clothing and food, will make it apparent to the most obtuse why labor troubles in the copper district are infrequent, and are unattended by violence and of short duration when they do occur.

From the excellently summarized statement of results furnished shareholders of the Wolverine, the following figures regarding operations for the year ending June 30, 1900, are secured;

Rock hoisted	215,951	tons
Rock stamped	184,594	tons
Cost per ton of rock hoisted	$ 1.52	
Cost per ton of rock stamped	1.77	
Cost per pound of ingot copper produced	8.14	cents
Cost per pound ingot copper, including construction	9.56	cents
Yield of ingot copper per ton of rock stamped	25.77	lbs.
Percentage of copper in rock stamped	1.288	per cent
Percentage of broken rock discarded	14.5	per cent

The Wolverine has four shafts, numbered from north to south, but of these only three are in commission. No. 1 was started too near the northern line of the property, and has long been exhausted. It is of no value to the Wolverine, but would be useful to the Kearsarge. No. 4 is the southernmost shaft, and will eventually be the deepest on the property. All are well equipped and are in good ground. Like all amygdaloids, the lode is bunchy, but it is kept opened well ahead of stoping, and there is no difficulty experienced in supplying the stamps with rock. For several years the monthly product of mineral has been remarkably constant, and is now averaging about 230 tons per month, which runs 87 to 88 per cent in ingot copper.

The mine is well equipped with boilers, hoisting machinery, air compressors and drills. There are good blacksmith, carpenter and machine shops and other buildings needed in the conduct of the business. There is a mill with one stamp on the lands of the mine, and another stamp is leased at the Allouez mill. A millsite has been purchased on Big Traverse Bay, Lake Superior, near the terminus of the Mohawk railroad, and a mill will be built at that point. The size has not been determined upon, but in all likelihood it will be a three-stamp mill, perhaps with room for an additional stamp and washing machinery provided against possible requirements of the future.

There is very little to criticise and a great deal to commend about the methods and management of the Wolverine. As that country is said to be the happiest which has the shortest history, the Wolverine may be considered fortunate in not being a "newsy" mine. Affairs run smoothly, with few interruptions, from one year to another. What changes occur in a twelvemonth are in the way of deeper openings, larger reserves of stoping ground, and sundry improvements on surface. The policy of the company is prudent, but

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not parsimonious. Both shareholders and employees are well taken care of, and neither is robbed that the other may fatten. The management, both at the mine and in the east, is composed of men who have served long and arduous apprenticeships in the copper industry, but with gray hairs there has come no lessening of activity, nor opposition to progressive methods. The Wolverine is a model mine.

ALLOUEZ.

The Allouez Mining Company has recently passed from the Stanton management into the so-called Fay group, of which Messrs. H. F. Fay and associates are in control. The eastern office is at 60 State street, Boston, Mass., with H. F. Fay president and W. B Mosman secretary and treasurer. Captain James Chynoweth of Calumet is the superintendent and Michigan director. The company is organized under the laws of Michigan and its annual meetings are held in March. The capitalization is 100,000 shares, of which 20,000 shares are in the treasury, the sale of which is intended to provide working funds as required in the future. The number of shareholders on Dec. 31, 1899, was 465.

The Allouez has levied assessments of $1,616,000 in all, and has never paid dividends. The mine was opened in 1859, on the wide conglomerate lode underlying the greenstone, which has since been known by the name of the mine which first opened upon it, as is the custom in naming the cupriferous lodes of this district. The mine is located in Sections 31 and 32, Town 57 North, Range 32 West, Keweenaw County, three miles north of the Calumet & Hecla, on a tract of 520 acres of land, all on the mineral belt, and with about half the area lying on either side of the greenstone, which at this point loses the height which renders it such a striking feature in the landscape of the eastern end of the Keweenaw Peninsula. The greenstone continues throughout Houghton and probably Ontonagon county, but in these counties has been so greatly eroded that it is but little above the level of the strata on either side.

Although organized in 1859, the Allouez company did not become a producer until ten years later. Considerable tracts of land were owned further east in Keweenaw county, on which but little effort was made to open paying copper deposits. Stimulated by the great success of the Hecla and Calumet mines, opened on the Calumet conglomerate, it was decided in 1869 to begin mining on the Allouez conglomerate, underlying the greenstone, and stratigraphically something like 1,800 feet west of the Calumet lode, in cross-section. Work was stopped in 1877 by the company, owing to utter exhaustion of the treasury, and the mine leased for two years to Messrs. Watson & Walls, who got out something like 50 tons of copper per month for the term of their lease, and made money. The company again resumed control in 1880, stimulated to further effort by the success of the tributors, who had paid a royalty of 12½ per cent on the gross production.

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Again the company was unable to earn the anticipated profits, and a further large sum of cash was expended in development and improvements. Once more Messrs. Watson & Walls took the mine, in 1885, and again made substantial profits, after paying their royalties, and succeeded in producing more copper than during their previous lease. The company once more took the mine, but was unable to make money in its operation, although great economy was practiced; and the property has been idle for some years, with the exception of the development and exploratory work carried on since 1898.

The lode is a strong one, running as wide as 30 feet in places, and occasionally as narrow as 10 feet, but averaging probably 18 to 20 feet. It has a strike of North 39 degrees East, with a dip to the northwest of 38 degrees with the horizon. Under various managements and systems of selecting rock and dressing at the mill, the percentage of ingot copper obtained has varied from 7/100 of 1 per cent to above one per cent. By very careful selection and the rejection of large amounts of rock broken, and leaving considerable ground unstoped, the percentage can be brought to quite a high figure, but not enough rock can be secured by such selection to allow a profit to be earned therefrom. The average return, were the lode rock to be mined from wall to wall, would probably be about the same as that of the Atlantic, or perhaps a trifle less. The rock breaks fairly well, but like all conglomerates is refractory under the stamps, and milling costs are high.

The old Allouez workings, on the conglomerate, have three shafts and the mine is quite deep. The maximum production was in 1885, when 1,085 tons 476 pounds of ingot copper were secured. The total product of the mine to date is 13,025 tons 1,528 pounds of refined copper, the last regular production having been made in 1892, in which year the low price of copper and the apparent impossibility of making a profit under existing conditions caused a cessation of work.

In addition to the tract of 520 acres on which the mine is located, the Allouez company owns considerable land to the northward, nearly all of which is on the mineral belt, and undoubtedly carries the ash-bed opened further to the northeast in the Arnold and adjoining mines. A mill, connected with the mine by a railroad, is located on Hill's creek and contains three stamps, one of which is under lease to the Wolverine mine, which has water sufficient only for the one head in use at its own mill.

The efforts of the present management are being devoted to the development of richer lodes than that possessed in the Allouez conglomerate, and to this end shafts have been sunk on the Osceola amygdaloid, which is highly remunerative three miles to the southward, and on an amygdaloid bed believed to be the Pewabic lode, which runs nine to ten feet in width, and carries considerable copper. In addition to the lodes named, a half dozen other amygdaloids are known to exist on the property, any of which are liable to prove productive, but the exact value of which can be determined only by opening. For the

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year ending Feb. 1, 1900, 181 feet of opening work was done on the Pewabic lode, while on the Osceola lode the shaft was sunk 504 feet, drifts were run to the extent of 1,474 feet and 132 feet of crosscutting was done. On Dec. 31, 1899, the company had a cash balance, over liabilities, of $5,865.27.

CENTENNIAL.

The Centennial mine is owned and operated by the Centennial Copper Mining Company. The main office is in the Massachusetts Block, 60 State street, Boston, Mass. H. F. Fay is president, W. B. Mosman secretary and treasurer, and the directors are Messrs. H. F. Fay, William A. Hazard, John C. Watson, Stephen R. Dow, Wm. Howell Reed, Edmund S. Clark and Jas. Chynoweth of Michigan. The company is incorporated under the laws of Michigan, with a capital of $2,500,000, divided into 100,000 shares of the par value of $25 each, of which 10,000 shares remain in the treasury. The number of shareholders of the company on Dec. 31, 1899, was 439. Local officials of the company are: James Chynoweth, superintendent; Charles Chynoweth, clerk; John Pentecost, mining captain; George Trevillian, wash boss.

The Centennial property comprises a little more than one square mile, consisting of all of Section 12, Town 56 North, Range 33 West, lying just north of the Calumet branch of the Calumet & Hecla; and also a triangular patch of land of about 20 acres, in the extreme northwest corner of the northwest quarter of the northwest quarter of Section 18, Town 56 North, Range 32 west. This was taken from the Old Colony tract, and was secured because it carried the outcrop of the Kearsarge lode, which underlies the entire square mile of the Centennial but does not outcrop at any point thereon, and could have been developed only by vertical shafts, had not the outcrop been secured on the patch of land in Section 18. The Centennial has for neighbors lands of St. Mary's Canal Mineral Land Company and of the Shelden-Douglass Estate, and the Kearsarge mine, on the north; on on the east the Wolverine and South Kearsarge mines; on the south the Calumet & Hecla, and on the west the Tamarack Junior and Calumet & Hecla.

The first mining was done in 1863 by the Schoolcraft company, but only a small amount of money was expended until the development of the Calumet to the south, in the latter sixties, caused the Schoolcraft company to open the northern extension of the conglomerate lode on which the Calumet and Hecla mines were developing bonanzas of value previously undreamed of in the Lake copper district. The Schoolcraft company expended a fortune and became bankrupt in the early seventies. The property was reorganized as the Centennial in 1876, and again became bankrupt in the early nineties, and was once more reorganized, as the present Centennial Copper Mining Company, late in 1896. Upwards of a million and a half dol-

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lars have been expended in various unsuccessful attempts to develope a paying mine on the conglomerate lode on Centennial lands. This work was on such a thorough scale and was so well done that the only conclusion possible to draw therefrom is that the conglomerate lode is not profitable at any point on the Centennial property. Occasional patches of excellent ground have been encountered, but the average is too poor in copper to pay for working. Seven shafts were sunk on the conglomerate in a stretch of nearly three-quarters of a mile, covering the entire outcrop of the lode on Centennial lands. Shafts 1, 2, 5 and 7 are all shallow, while 4 and 6 are of considerable depth and No. 3 is one of the deepest in the world, having been put down 3,200 feet on the dip of the lode, which is about 37 degrees on the Centennial lands.

Despite the thorough test previously given the conglomerate on the Centennial tract, the present management devoted a little effort to the conglomerate in 1897, after the reorganization. The possibilities of opening another Calumet & Hecla were very tempting. No. 6 shaft, which was 500 feet deep, was put down 700 feet additional, and considerable drifting done. Copper was found to a limited extent at many points, but not in sufficient quantity to pay for working, hence the effort to open a mine on the conglomerate soon came to an end.

Shafts Nos. 3 and 6 of the Centennial on the conglomerate are each 7 x 18 feet, and of three-compartment size. No. 4 shaft, the next deepest, is down 1,100 feet. It seems a pity that such fine shafts, sunk at so great a cost, should remain idle and worthless, yet the most profitable use to which they can possibly be put is to allow them to rot without a human being ever setting foot in them again.

After becoming satisfied that the quest for good ground on the northern end of the conglomerate was hopeless, the management turned its attention to the shafts on the Osceola lode. This amygdaloid underlies the conglomerate at a distance of slightly less than 750 feet on the Centennial lands, and two shafts had been sunk thereon by the old management, under Capt. Johnson Vivian, previous to the suspension in 1892. The dip of these shafts is 38 degrees, and the strike of the lode about North 40 degrees East. The shafts were both of comparatively shallow depth when Capt. Chynoweth resumed sinking in them, in the fall of 1897. On Feb. 1, 1900, No. 1 shaft was down 1,050 feet, and No. 2 was 1,150 feet deep. Stoping was resumed at the same time as sinking, and the old stamp mill started, although the mine was insufficiently developed to give a full supply of rock to the mill, a state of affairs which under ordinary conditions would have rendered it unwise to begin milling—but the conditions in the case of the Centennial were exceptional. The mill was on the ground at the mine, and was supplied with machinery and capable of being started on a day's notice, at practically no cost except for fuel and labor. The small production achieved by the mill, averaging only about 25 tons of ingot per month, has affected the stock of the Centennial ad-

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versely in the market, but on the other hand the mill has been of considerable aid in paying for the expensive development work undertaken at various points, so that from a strictly mining standpoint its working was and remains the correct policy. The mine is rapidly getting to the point where a new mill must be considered, but with a mill to hand, the 1899 production, worth nearly $100,000, has come in very conveniently as a source of revenue.

The shafts on the Osceola lode are 7 x 12 feet each, with a single skipway and a compartment for ladders, pipes and wires. A large amount of opening work has been done in the past two years, with only sufficient stoping to feed the single old stamp at the mill. As many as sixteen power drills have been in simultaneous use in these two shafts. The lode is scarcely as rich as to the southward, but is of workable quality throughout, with occasional bunches of very rich ground. Opened on a large scale and treated at a modern mill, it can be made to pay a profit.

In the fall of 1899 work was begun on the Kearsarge lode. It had been proposed to sink a vertical shaft to the lode on the southeast corner of the Centennial lands, thence from the point of contact downward, on the angle of the lode itself; but the bargain by which the Centennial company secured 20 acres of land carrying the outcrop, and a right of way for the shaft through the South Kearsarge, where the four sections corner, rendered it unnecessary to follow this plan. No. 1 shaft on the Kearsarge was started on the outcrop of the lode in September, 1899, and has been pushed with remarkable speed from that time. The shaft penetrated a heavy overburden, and is considered by mining men to have been sunk through the sand to the solid ledge of rock in an unusually short time. The shaft is started from surface at an angle of 40 degrees with the horizon, changing to an angle of 39 degrees, to conform to the lode, at the depth of about 150 feet. The shaft penetrates 110 feet of overburden, through which it is timbered with great solidity, to guard against the possibility of accident in the future. It is 7 x 18 feet in size, inside of timbers, having two skipways and a manway which also carries the air and water pipes. The first level is 70 feet below the ledge, at a depth of 180 feet from surface, the unusual depth of the first level being necessitated by the heavy overburden. At this writing, Nov. 1, 1900, the shaft is about 800 feet in depth and being sunk steadily. Levels have been opened, drifts being run in the foot. Owing to the unusual shape of the land owned by the company on this lode, the levels are short on each side of the shaft until it passes over the line into Section 12, the square mile owned by the Centennial company, after which the levels widen rapidly, spreading out like a fan as depth is gained. Good air is being secured for this shaft by a crosscut connecting with a vertical exploring shaft sunk for the Kearsarge lode before the acquisition of the tract on which the incline shaft is now sunk.

On surface at the Kearsarge shaft permanent improvements have

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been made which are well calculated for efficient work. There is a combination shafthouse and rockhouse 36 feet 4 inches by 42 feet, fitted with the usual crushers, grizzleys and pockets. A fine boiler house, 56 x 60 feet in size, fitted with every convenience for receiving coal and discharging ashes, and containing two 125 horse power boilers, was constructed and equipped in the winter of 1899-1900. A new compressor house and an engine house were built, and sites have been selected for the other buildings required near a large shaft. The present showing of mineral-bearing ground at the Kearsarge shaft is excellent. Little stoping is being done, but the rock broken from shaft and drifts, amounting to a considerable tonnage, is sent to the mill as hoisted, and gives good results. The lode runs 15 to 20 feet wide, and displays about the same characteristics as to the northward, on the Kearsarge and Wolverine properties.

The Centennial is well supplied with mine buildings and machinery. There is a new machine shop, fully fitted with modern tools; carpenter shop, blacksmith shop, etc., all in a row; beside the usual barns, warehouses, office building, etc.; dwellings for employees, in addition to the new structures previously noted at the Kearsarge shaft The new compressor at that shaft is of 35-drill capacity, and one of the best in the district.

The old Centennial mill is at the mine, and gets its water from a dam, the supply being adequate for only one stamp. The stamp itself is of ancient pattern, while the jigs used are nearly a quarter of a century old. It is a rattle-trap sort of outfit, yet the results secured there are surprisingly good, the percentage of copper lost in the tailings being as low as at any mine in the district, and much below the average. This result is secured only by great care and no small ability on the part of the management and men, and reflects credit on all concerned. While the mill is highly efficient, so far as saving the copper is concerned, it cannot advantageously treat over 200 tons of rock daily, and the costs are necessarily much higher than at a modern mill, fitted with every device for economical as well as thorough work. The old mill is serving a very useful purpose at present, but it must soon be replaced with something better. The Centennial company purchased a fine millsite on Torch Lake, opposite the mills of the Calumet & Hecla, in 1898. A large bonus for the site has since been offered and refused, it being intended to build the new mill there rather than to sell the land at a profit. It is almost the only inland millsite remaining unused in the copper district, nearly all of the new mills being forced to go to Lake Superior, to obtain necessary sandroom.

The Centennial now has four compressors, of 10, 12, 15 and 35 drill power respectively, giving a total capacity of 72 drills. There are three boilers of 100 h. p. each at No. 4 Osceola shaft, and two of 100 h. p. each at No. 1 Osceola shaft, in addition to those at the Kearsarge shaft and at the shops, mill, etc. Railroad connections have been built to all parts of the mine, insuring the most economical handling

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of fuel, rock, and supplies of all sorts. About 200 men are now employed at the property.

A very valuable asset of the Centennial company, which has not been taken into consideration until recently, is the real estate suitable for building purposes. The mining camp of Calumet, in which the Centennial is located, is at present the most populous in the world, though Johannesburg, on the South African Rand, is larger in times of peace. The demand for building lots is great, an average of 500 dwellings being erected annually in the camp. The Centennial has platted and sold two additions, known as Centennial Heights, situated on high land, during the year 1900. These are being rapidly built up, and their improvement enhances the value of the adjoining lands of the company. While the Centennial owns a square mile of surface including the mineral rights below, all lots are sold with mineral rights reserved, as is customary in this district. Only a comparatively small part of the large area owned is required for the surface operations of the mine, and most of the balance is available for building purposes. The Centennial company is not only deriving a large revenue from the sale of lots, but is doing the community a substantial service by furnishing ground to supply the demands of a rapidly growing city. With the completion of the inter-urban street car line, which is already running at the Portage Lake towns and is built half way to Calumet, the Centennial lands will grow even more valuable from year to year, for residence purposes.

The balance of assets of the Centennial company, on Dec. 31, 1899, was $136,452.98. The revenue during 1900, from sales of copper produced and from lots sold, has been quite large, and the company will probably make a better financial showing at the close of the present year than has been anticipated by shareholders. It will require an assessment, however, to build and equip a large stampmill. The following items are taken from the sworn statement of the company furnished the State of Michigan under date Dec. 31, 1899:

Amount of cash paid in on capital stock....	$585,000.00
Amount paid in by conveyance of property.	.....
Amount invested in real estate.....	185,055.00
Amount of personal estate	136,452.98
Amount of floating debt.....	.....
Amount due corporation.....	.....

In explanation of the lack of floating indebtedness, which every mine carries, it may be stated that the bookkeeper of the company, in his report to the state, deducted the floating indebtedness of $20,596.58 from actual cash assets of $157,049.56. The result of this system of bookkeeping is the same as that of the other methods, but the plan followed being different from that pursued by most of the mining companies in making their reports to the state, the lack of floating debt might appear strange without an explanation.

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CALUMET & HECLA.

There are so many points of interest regarding this property, and its scale of operations is on such a colossal plan, that only the merest skeleton of facts and figures of interest can be given in a work of the present scope. A large volume might easily be written upon the property, without exhausting the possibilities of the subject. Of all the world's mines of diamonds, gold, silver, copper and other metals, the Calumet & Hecla is the most profitable, the deepest, the largest employer of labor, the owner of the most powerful machinery and the greatest consumer of coal.

The Calumet & Hecla Mining Company was incorporated in 1872, and took over the Hecla and Calumet mines, adjoining properties opened on the Calumet conglomerate lode, and which had jointly paid dividends of $850,000 previous to their consolidation. They are still worked as two separate mines, with distinct local staffs and separate mills, but with the same chief officers. Alexander Agassiz is president, Geo. A. Flagg secretary and treasurer, with the main office at 12 Ashburton Place, Boston, Mass. At the mine, S. B. Whiting is general manager, S. D. Warriner, superintendent; John Duncan, assistant superintendent; Col. Preston C. F. West, engineer; J. H. Lathrop, clerk, and Col. J. N. Cox, cashier. Frederick G. Coggin is superintendent of the stampmills at Lake Linden; J. B. Cooper, superintendent of the smelters at Lake Linden, and M. B. Patch superintendent of the smelters at Black Rock, Buffalo. Senator Chas. Smith is clerk of the Lake Linden smelters. W. A. Childs is superintendent of the Hecla & Torch Lake Railroad, which handles the immense traffic of the Calumet & Hecla between the mine and mill. This road probably handles the largest tonnage per mile of main line of any railroad in the world.

The number of shareholders of the Calumet & Hecla company on Dec. 31, 1899, was 3,080, or nearly twice that of any other Lake Superior copper mining company.

The mineral lands of the company comprise about 2,750 acres, in a compact tract in Sections 11, 13, 14, 15, 22, 23 and 24, Town 56 North, Range 33 West. The company also owns considerable tracts west of the Tamarack, on the mineral belt, which undoubtedly carry the underlay of the Calumet conglomerate, but at such stupendous depths that the project of opening shafts thereon has not as yet been seriously taken up, although given consideration as a possibility of the future. The Calumet & Hecla already has the deepest shaft in the world, in the Red Jacket vertical, which is 4,900 feet from collar to sump, but it would require a vertical shaft of about two miles in depth to reach the conglomerate on the lands west of the Tamarack. The cost of sinking such a shaft and equipping it with adequate machinery would probably be not less than eight to ten millions of dollars and the heat at such great depth would prohibit mining, unless artificial refrigeration were provided to temper the air.

In addition to the mineral lands of the company, the Calumet & Hecla owns vast tracts of forest land in various portions of the upper

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Hecla owns vast tracts of forest land in various portions of the upper peninsula of Michigan. It is apparently the policy of the company to hold these lands without denuding them of their covering of pine, purchasing such timber as may be required, as a rule; though some timber is cut annually from the lands of the company. In view of the steadily appreciating price of white pine this policy is probably a profitable one.

The neighbors of the Calumet & Hecla are the Tamarack, Tamarack Junior and Centennial on the north, Old Colony and St. Louis (the mineral rights of which belong to the C. & H.) on the east; the Laurium and Osceola on the south, and the Tamarack and undeveloped mineral lands on the west.

The total assessments levied on the Hecla and Calumet mines, previous to their consolidation, were $1,200,000. The dividends of the Calumet & Hecla to Oct. 1, 1900, have been $70,850,000. But one mine, the Consolidated California & Virginia, has ever paid larger dividends, and before the end of the year 1901 the Calumet & Hecla will have paid a larger sum than has ever before been returned in profits by any mine in the history of the world. The Consolidated California & Virginia is now practically an abandoned property, worth but a few thousand dollars, while the Calumet & Hecla, at the present writing, Oct. 30, 1900, is worth very nearly $80,000,000.

The Calumet company was organized in 1865, and the discoveries made on surface were of phenomenal richness. In 1866 the Hecla was set off as a sort of stock dividend to shareholders. The Hecla was the first to pay a dividend, of $5 per share, in December, 1869, while the Calumet disbursed a similar amount one month later, in January, 1870. Each company had 20,000 shares. In the spring of 1871 the two companies were consolidated, under the present title of the corporation, and the stock increased to 40,000 shares. A stock dividend of 10,000 shares brought the capitalization to 50,000 shares and in 1873 the number was increased to 80,000. In 1880 the capital stock was increased to 100,000 shares, the present maximum allowed mining corporations by the laws of the state.

The production of refined copper by years will be found in the statistical section of this volume, where the dividends by years are also given, as well as much other statistical information which appears in that part of the book in a fraction of the space that would have been required to distribute the figures under the captions of the various mines.

The statements of assets and liabilities for the fiscal years ending April 30, given the shareholders at the annual meetings for the past three years, are as follows:

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Assets.	1900.	1899.	1898.
Cash and copper.....	$5,902,859	$5,335,079	$7,102,664
Bills receivable.....	573,576	801,238	543,335
Insurance fund.....	504,583	353,647	205,650
Totals.....	6,981,019	6,489,964	7,851,650
Liabilities.			
Bills payable, etc....	$ 495,156	$ 446,419	$ 438,194
Machinery contracts.	1,425,000	645,000	855,000
Set aside.....	800,000	1,000,000	.....
Totals.....	2,720,160	2,091,420	1,293,194
Balance of Assets....	4,260,858	4,398,544	6,558,456

According to the official sworn statement returned to the State of Michigan, under date Dec. 31, 1899, some of the figures relating to the affairs of the corporation were as follows:

Amount of cash paid in on capital stock....	$ 1,200,000.00
Amount paid in by conveyance of property.	.....
Amount invested in real estate.....	14,032,990.00
Amount of personal estate.....	7,215,716.42
Amount of floating debt.....	2,298,466.55
Amount due corporation.....	1,669,622.00

The company does not give detailed figures to its shareholders, but contents itself with an annual report of exceeding brevity, wherein the exact financial status of the company at the date of the annual meeting is set forth, with a statement of actual production of copper, in mineral and ingot, for the fiscal year, and a short summary of the principal improvements effected. For this reason it is impossible to give detailed figures regarding costs and products, such as are shown in the articles on the Atlantic, Quincy, and other mines of the district. The statements given shareholders are remarkably meagre, but as the dividends are phenomenally large, the stockholders content themselves with the minimum of information regarding their property, and the maximum of profits derived therefrom.

The profits of the mine have been made from the Calumet conglomerate, which has also enriched the owners of the Tamarack mine working on the underlay, but has impoverished corporations working on the Centennial tract, just to the north, previous to the present reorganization of the Centennial company, which is developing mines on other lodes. Just why the Calumet & Hecla should get all the cream of this lode and the others nothing but very much diluted skim milk is a mystery, the solution of which has not only proved impossible, but attempts at the solution of which have been very costly to those making the trials.

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While the vast profits of the Calumet & Hecla have come from the conglomerate, the company possesses other cupriferous lodes rich in copper, and has opened a large mine on one of these, the Osceola amygdaloid, within the past three years. During the month of October, 1900, a considerable number of men were laid off from the amygdaloid workings, due to the mine being opened well ahead for production, while the machinery ordered for its working has been greatly delayed. The Osceola amygdaloid underlies the Calumet conglomerate at an average distance of 730 feet to the east. The Osceola mine was originally opened on the conglomerate, but only a few acres of this on Osceola lands proving profitable, the underlying amygdaloid was attacked, with the result of finally placing the Osceola, after heavy assessments and many tribulations, in fourth place among the great mines of the district. The success of the Osceola in the past few years has led the Calumet & Hecla to attack the same lode, which traverses the Calumet & Hecla lands for about two and a quarter miles. Five shafts have been sunk on this lode, numbered from 13 to 17, inclusive. All are of large size and of the best design and construction, well timbered, and put down in the shortest time compatible with good work. The amygdaloid has been found rich, at least as rich as on the Osceola lands to the south and possibly richer, though this is a point which can only be determined after stoping has been begun in earnest. One head has been kept running on this rock at the Hecla mill, with excellent results, most of the supply coming from the opening work in shafts and drifts, though a limited amount of stoping has been done to make up any deficiency in rock broken by development work. The finding of rich rock on the Osceola amygdaloid, where opened on the Calumet & Hecla lands, effectually disposes of the old theory that the amygdaloids are lean in the cross-sections where the rich conglomerates are found, and vice versa.

In addition to the Osceola, on which a large mine has already been opened, the Calumet & Hecla lands carry the Kearsarge amygdaloid. This is a very bunchy amygdaloid, rich in spots and almost barren in others. It has been thought of rather poorly by mining men until the past four or five years. The Wolverine, opened on this lode in 1882, made a dismal failure, and was apparently a losing venture until a comparatively recent period. The Kearsarge, opened on the same lode just north of the Wolverine, was not a success in its early years, but with the opening of these two mines on a larger scale, allowing proper selection of rock and adequate supply for the stamps, profits were earned, even with copper at its low record price of nine cents per pound; and at present no amygdaloid lode in the copper district is in stronger demand or being opened upon at more points. The developments of the past five years warrant the assertion that the Kearsarge is one of the master lodes of the district. At present it is being developed immediately north of the Calumet & Hecla boundary, in the South Kearsarge mine of the Osceola company, and it is certainly merely a

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question of time when the Calumet & Hecla management will also open upon it.

In addition to the Calumet conglomerate and the Osceola and Kearsarge amygdaloids, there are other amygdaloid lodes outcropping on the C. & H. lands and underlying its property, but none of marked promise, though future developments may render some of them valuable. The two amygdaloids previously named are of demonstrated value, as mines on either side of the Calumet & Hecla are working them at a profit.

There is a marked absence on the Calumet & Hecla lands of the cupriferous fissures so extensively exploited in the Keweenaw county mines to the northeast. In all of the extensive underground openings of the Calumet & Hecla, two miles in length by a mile and a quarter deep on the incline of the lode, no fissures of value have been encountered.

The average strike of the conglomerate is North 39 degrees East, and the dip is to the west of north at an average angle of 37½ degrees with the horizon. The Osceola amygdaloid has a strike parallel with that of the conglomerate and a dip of about 40 degrees. While not traced, the strike of the Kearsarge is probably about parallel with that of the two other lodes named, and its dip will probably be found to be about 41 degrees, as it is nearer the underlying sandstone, where the dip of the trap strata is sharpest.

The shafts of the mine are as follows, beginning on the north and running to the southern line of the conglomerate, at the Osceola boundary, thence on the Osceola lode from south to north;

No. 5 Calumet. Two compartment.
No. 4 Calumet. Two compartment.
No. 3 Calumet. Abandoned.
No. 2 Calumet. Two compartment.
No. 1 Calumet. Abandoned.
No. 1 Hecla. Abandoned.
No. 2 Hecla. Two compartment.
No. 3 Hecla. One compartment.
No. 4 Hecla. One compartment.
No. 6 Hecla. One compartment.
No. 7 Hecla. One compartment.
No. 8 South Hecla. Two compartment.
Nos. 9 and 10 South Hecla. Two shafts in one.
No. 11 South Hecla. One compartment.
No. 12 South Hecla. One compartment.
No. 13 Amygdaloid. Two compartment.
No. 14 Amygdaloid. Two compartment.
No. 15 Amygdaloid. Two compartment.
No. 16 Amygdaloid. Two compartment.
No. 17 Amygdaloid. Two compartment.
Red Jacket Vertical. Six compartment. Deepest in the world.

This gives eight inclined working shafts and a single vertical shaft equal to six ordinary shafts, on the conglomerate, and five double

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shafts on the Osceola amygdaloid. The Red Jacket vertical shaft was started after the second fire in the mine, in 1888, and cut the lode at a depth of 3,287 feet. It is bottomed at the depth of 4,900 feet, from which depth it will be possible to crosscut and intercept the lode at its deepest point on the Calumet & Hecla tract.

The equipment of these shafts is of the best. Many of the older shafthouses and rockhouses have been replaced in the past three or four years, bringing the entire surface equipment for handling rock up to the highest efficiency. The shafthouses at the incline shafts are of uniform pattern. At each the rock is hoisted from the mine to the top of the shafthouse, where it passes over "grizzleys", which allow the finer rock to fall through, the larger masses being reduced in crushers of the jaw type with openings two by three feet. On the floor below there is an 18 x 24 inch crusher in each shafthouse. After being crushed the rock falls by gravity into storage bins, whence it is dumped into the hopper-cars that take it to the mills at Lake Linden, railroad tracks running underneath each rockhouse. The hoisting engines at these shafts are among the most powerful in the world, ranging from 1,000 horse power upward.

The surface equipment at the Red Jacket vertical shaft is in keeping with the shaft itself, which is nearly a mile in depth and required nine years to sink. A quadruple hoist of 8,000 horse power is installed in a magnificent brownstone building, 70 x 220 feet in size, equal in design and material to the most palatial structures erected for business or residence purposes. In an adjoining building, 70 x 150 feet in size, also of selected Lake Superior redstone, are housed ten boilers, each of 1,000 horse power. At the rear of the engine house is an annex, also of redstone, floored with imported Portland cement and roofed with Bangor slate, 32 feet wide and 412 feet long, in which is carried the fleet gear used in securing counterbalance in hoisting. In hoisting ten-ton loads perpendicularly from a depth of nearly a mile, the weight of the cage and steel cable nearly equals that of the cargo of rock. To secure the benefits of counterbalance, yet allow the hoisting of rock at will from any of the many levels opened, the hoisting cable is made continuous for both compartments, being over two miles in length. Several turns of this cable are taken around each hoisting drum, and the surplus cable in the centre of its length is taken back of the drums into the tail-house, where it passes around a large sheave-wheel. This moves horizontally on trunnions, and the adjustment for different levels is made easily and quickly, as required. With the aid of the counterbalance secured by this device, the powerful engines hoist ten-ton loads at the rate of forty miles an hour, the hoisting speed being about 90 seconds for the vertical distance of nearly a mile —this allowing for starting and stopping. No locomotive ever built could duplicate the record on a horizontal plane.

The combination shafthouse and rockhouse at the Red Jacket vertical is in keeping with the other features of this great shaft, being

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the largest ever constructed, of steel throughout and fitted with breakers capable of handling one to two thousand tons of rock daily. The smokestack of the boiler house is 250 feet high, with an inside diameter of 12½ feet.

Notwithstanding the enormous depth of this shaft, it is greater in capacity than all but half a dozen of the world's very largest mines. Could the material be supplied, the shaft is built and equipped to raise more rock daily than the entire Calumet & Hecla mine is now producing, and in 300 working days of twenty hours each, could hoist, from the full depth of nearly one mile, twice as much rock as the annual output of the largest iron mine of the Lake Superior district. In depth, capacity and equipment, this shaft stands alone among the world's mines.

The rock temperature in the sump of the Red Jacket shaft, when first bottomed, was 87⅘ degrees Fahrenheit—decidedly warm for labor by miners and trammers. Since connection has been secured with No. 4 Calumet by means of crosscuts, the temperature has been reduced to between 70 and 80 degrees. The exhaust air from the power drills aids in cooling the mine, which is decidedly warm, but by no means uncomfortable when the workmen have become habituated to the temperature.

In the incline shafts of the mine, underground employees are hoisted and lowered by man-cars. These are long trucks with tiers of circus seats, which are lifted off and on the track as required. They are economical of time and effort, and safe.

The conglomerate is opened for a distance of about two miles, on the company's lands. The amygdaloid shafts are about 2,300 feet apart, and have opened a stretch of nearly two miles on this lode. No additional shafts will be required on the amygdaloid or conglomerate workings, though additional shafts will eventually be required on the Kearsarge amygdaloid, when that is opened. For the southern half of the two miles of Kearsarge lode possessed by the Calumet & Hecla, the outcrop is in the village of Laurium, a suburb of Calumet which has about 6,000 people. To mine from this portion, it would be necessary to sink vertical shafts to intercept the lode to the west; buy the improved property required for the shafts and engine houses, or work that stretch of ground from shafts to the north and south by means of power haulage plants installed underground. The problem will doubtless be satisfactorily solved when it presses for solution, which may not be for some years. The Calumet & Hecla also owns the outcrop of the Kearsarge for another mile, south of the village of Laurium, but controls the mineral right to the underlay for but little depth in the northern half of the lower Laurium tract.

Generally speaking, the richer ground of the mine is toward the center, though some exceptionally rich ground has been found in No. 5 Calumet, the northernmost shaft, and the Red Jacket shaft, which is about in a line with No. 4 Calumet shaft produced, is also in excel-

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lent ground. The southernmost shaft of the South Hecla or Black Hills portion of the mine has been put down to great depth, but has not encountered much rich ground. To the north of No. 5 Calumet there is a considerable stretch of ground up to the Centennial line, which is supposed to be poor. The work done on either side of this block of ground by the Calumet & Hecla and Centennial supports this opinion.

Pillars 75 feet wide are left on either side of every shaft, at the various levels. When the present conglomerate workings are exhausted down to the Tamarack line, which will be at a time variously estimated at 35 to 50 years, there will be millions of dollars worth of copper remaining in the pillars supporting the incline shafts. A conservative estimate would be that 15 per cent of the lode rock is left unmined, in these pillars. This can eventually be secured, but cannot be safely taken until the time comes to rob the old workings, by which time the inventive genius of the twentieth century, backed by the millions of the corporation, should have solved the problem of mining at the depth of two miles, thus permitting the Calumet & Hecla to open a new bonanza beyond the Tamarack, to replace the original mine on the outcrop of the conglomerate.

The quantity of timber used in the mine is very large, amounting to about 30,000,000 feet annually for the conglomerate and amygdaloid mines, and in addition many other millions of feet of lumber are required on surface.

A complete technical description of the machinery of the Calumet & Hecla would easily consume a hundred pages of this book, without undue elaboration. The merest summary of the more important and striking figures is therefore all that can be given here. The principal objective point for visitors to this mine is the "Jumbo" engine house, at the Calumet branch. This is easily accessible and the employees have been chosen for their ability to attend to business and not become ruffled at the daily repetition of questions ranging from inquisitorial to ridiculous. The engine house is 62 x 146 feet in size, of brick. In this engine house are located the big Corliss engine "Superior," of 4,700 horse power, having 40 inch cylinders and 70 x 72 inch stroke, also the auxiliary engines "Baraga" and "Rockland," of 2,000 and 600 horse power respectively; two Rand air compressors with capacities of 25 and 40 drills; and the engine "Mackinac," a quadruple-cylinder triple-expansion steel giant of 7,000 horse power. In this building are four drums, 8½ feet wide and 20½ feet in diameter, which hoist from four different shafts, two of these drums carrying more than a mile and a quarter each of inch-and-a-quarter steel cable. Power is furnished by batteries of boilers in two boiler houses adjoining, draft for which is furnished by a brick chimney 250 feet high and of 12½ feet inside diameter. Locomotives haul the coal into these boiler houses, and it is fed into the grates by automatic stokers. There are few points on the globe's surface where such a variety of mammoth machinery can be seen as at the Superior engine house.

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The Hecla engine house is on a more modest scale, both as to size and machinery contents, but is only relatively a small affair. The building is of brick, 47 x 80 feet in size, flanked by a large boiler house, and contains the compound hoisting engine "Frontenac" of 2,000 horse power; also two auxiliary engines of 600 and 900 horse power; one Rand air compressor of 30-drill capacity and a pair of water-plunger air compressors with a combined capacity of 144 drills—much the largest compressor of this type ever constructed, if not the most powerful ever built.

South of the Hecla engine house is the engine house known locally as the "G., H. & S.," from the initials of its three engines, the "Gratiot," "Huron" and "Seneca," of 2,000 horse power each. The boiler house has five boilers and a stack 200 feet high, of 9½ feet internal diameter.

Still further south is the engine house operating Hecla shafts 7 and 8, containing the engines "Hancock" and "Pewabic," each of 2,000 horse power and operating immense drums of 25 feet diameter, by means of spur gearing. A boiler house 50 x 120 feet houses ten boilers, and has a smoke stack 250 feet high and of 12½ feet internal diameter. The three 250-foot smoke stacks of the Calumet & Hecla are visible for many miles, and are plainly seen from the main traveled course of vessels plying Lake Superior.

At the South Hecla there are two engine houses, that hoist from Nos. 9 and 10 shafts, containing the engines "Detroit" and "Onota," of 1,000 horse power each. The engine house at shafts 11 and 12 has engines of similar capacity.

The machinery at the amygdaloid shafts is of considerably lesser power than on the conglomerate openings, but will doubtless in time be replaced by as heavy machinery as is now in use at the older shafts, as the workings on the Osceola attain great depth.

In the way of necessary surface buildings and machinery the Calumet & Hecla has a marvelously complete equipment. Everything is duplicated, so that the minimum of delay would be occasioned by fire or accident. There are carpenter shops, fitted with every wood-working appliance; three large blacksmith shops, with steam-hammers, forges, emery wheels, grindstones, etc.; a mammoth machine shop 225 x 250 feet in size filled with the costliest and best planers, lathes, drills and machinery of all kinds required in the work of the mine, capable of anything from drilling bolt-holes to finishing a steel forging weighing many tons. The company has no foundry, but the rumor that one is to be established is of perennial circulation. There is an immense brick warehouse, which contains the vast quantities of supplies required by the mine in its various branches of work, the policy of the management being to keep an ample supply of every article required. There is a large round-house for the locomotives, and of minor buildings, such as paint-shops, oil houses, barns, etc., a considerable number. A timber mill mortises and tenons the stull timber and cross-pieces

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used in the underground sets. There is an electrical building, of stone, 74 feet square. This furnishes electric light and power for the mine and location. In addition to the mine pumps of the ordinary type, there are electric pumps, used mainly as auxiliaries.

The Calumet & Hecla mine has suffered severely from fires, and the timber used underground is now fire-proofed with a chloride of zinc solution. An elaborate system of fire protection has been devised and installed, including electric signal systems, water pipes, hydrants, hose, chemical engines, etc., all underground. A complete telephone system has been installed underground, a private exchange being operated by the company. This is metallic circuit throughout, and has about 80 instruments on surface and underground. It is connected with the long distance Bell system, and if required, it would be possible for the president of the company, in Boston, to talk with the pumpman at either pump on the 41st level of the mine, more than three-quarters of a mile in the bowels of the earth, without the former leaving his chair, or the pumpman his station. The value of this elaborate system of guarding against and fighting underground fires has been frequently questioned, but the experience of May, 1900, offers conclusive evidence that the money and thought lavished on the work have not been expended in vain. The Calumet & Hecla mine is the greatest single insurance risk in the world, and one on which no insurance company would place a dollar of indemnity. It devolves on the management of the mine to furnish its own protection, and the officials deserve commendation rather than blame for the earnest efforts made to eliminate this, the greatest risk known to miners, or if elimination is impossible, as is probably the case, to reduce the risk to the minimum.

The Calumet & Hecla suffered severely from fires in 1887, and again in 1889. Three of the shafts were so badly damaged that they were abandoned, and the direct loss, while enormous, was probably less than the indirect injury, through loss of profits which might have been earned but for the interruption of work. There was also loss of life, and the Calumet & Hecla is to be commended in the highest degree for the strenuous efforts persistently made to reduce the natural risks of life and limb to the lowest possible limit. When fire broke out in No. 3 Hecla shaft, on May 27, 1900, the system of fire protection installed in the mine was given a severe test. The fire was discovered on Sunday evening, when the mine was deserted except by pumpmen, watchmen and a few other employes. It had gained great headway before discovered, and a large section of the mine was in danger. The fire doors were closed wherever possible, but the flames had gained such a start that any attempt to extinguish them with water or chemicals was out of the question. The burning portion of the mine was cut off by closing the fire doors, though the gas prevented confining the exposed portion to the narrow limits which would have been possible had the discovery been made even a few minutes sooner. As

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it was, there were narrow escapes for some of the men engaged in this dangerous work. As soon as possible the shafts were all sealed at surface by placing heavy timbers across, and tamping dirt tightly into the crevices. Wherever gas escaped through cracks in the earth, dirt was tamped into them and made solid with water. The fire was extinguished within three weeks, and the South Hecla portion of the mine continued working without interruption. No. 3 shaft was badly injured, and the work of rebuilding is still in progress, but the fire might easily have done much greater damage. Criticism of the efforts made to guard against fire in the Calumet & Hecla are puerile. It would be just as reasonable to cry out against the cost of maintaining fire departments in the great cities, because the flames occasionally cause heavy damage or loss of life. It is probably beyond human prescience to devise a method for entirely safeguarding this mine against danger from fire under any and all circumstances, but the preventive measures already taken are in the line of common-sense and ordinary business prudence, and as such cannot be criticised by sensible men.

In addition to the underground fire protection, the company maintains on surface a complete fire department, modeled on metropolitan lines and having the latest fire-fighting apparatus. This affords protection to the mine buildings and location, and responds to all calls from the neighboring villages of Red Jacket and Laurium.

The stamp mills of the company are located at Lake Linden, four miles from the mine, where the company owns about 1,000 acres of land, including several miles of frontage on Torch Lake. There are two mills, the "Calumet" and "Hecla," with a third mill now building to treat rock from the amygdaloid shafts. The two mills contain 11 stamps each, and are duplicates. The new mill will have only 6 stamps, but as the amygdaloid rock is much more easily crushed than the conglomerate, the capacity of the latter will be but little less than either of the old mills. The Calumet & Hecla management estimates the capacity of the new mill at 2,500 tons of amygdaloid rock daily, a conservative figure, as the stamps at the new mills of the Franklin and Arcadian companies are capable of treating 500 to 550 tons daily, on sustained runs. It is probable that the milling capacity of the Calumet & Hecla, after the completion of the new mill, will be very nearly 7,000 tons of conglomerate and 3,000 tons of amygdaloid daily.

The two old mills contain 22 Leavitt steam stamps, with cylinders 14 x 21½ inches, with 24-inch stroke, and the necessary complement of jigs, slime-tables, etc. Wilfley tables have been in experimental use on the fine slimes, and are found valuable in saving the extra fine particles of metal which the slime-tables have lost. The mills stand on the shore of Torch Lake, and water is furnished for washing the stamped rock by the pumping engine "Michigan," much the largest pump in the world, which has a capacity of 65,000,000 gallons daily. There are also three auxiliary pumps, the "Erie," of 10,000,000 gallons

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daily capacity, and the "Huron" and "Ontario" pumping engines, of 20,000,000 gallons daily capacity each.

The daily disposition of an average of upwards of 5,000 tons of stamp sand is something of a problem. The shores of the lake were filled with stamp sand in a few years after the mills started, and it became necessary to elevate the "sludge" of sand and water. To this end a sand wheel was devised. This is a big wheel having wooden buckets on its inner perimeter, which takes the "sludge" from the pit in which it is deposited by the launders from the mill, and elevates the sand in solution to a launder on high trestles, which carries the sand and water far out into the lake. There are four of these wheels, two of forty and two of fifty feet diameter, with a combined daily capacity of 8,200 tons of sand and 100,000,000 gallons of water. These wheels are housed in separate buildings. The construction of the new mill having necessitated additional sand-wheel capacity, a fifth wheel has been ordered and is now being built. This will be 60 feet in diameter and will have a capacity considerably greater than any of the wheels now in use.

The company smelts all its own copper. The metal comes from the jigs and slime-tables in the form of "mineral," which carries an average of about two-thirds copper. It is possible to dress the mineral to a much higher percentage of copper, but in so doing a considerable portion of the finer particles of copper is lost in the tailings. The one-third waste matter is the gangue of conglomerate rock adhering to the metal after dressed at the mills.

The company has two smelters, one at South Lake Linden and one at Black Rock, Buffalo. The Lake Linden smelter was built in 1887, previous to which the Calumet & Hecla mineral was smelted at Hancock. The Lake Linden smelters have been added to from year to year since first built, in accordance with the general plan of expansion followed by the Calumet & Hecla company, and now cover the major portion of a thirty-acre tract of land lying a short distance south of the stamp mills on Torch Lake. The main buildings of the smelter plant consist of four furnace buildings, each 80 x 130 feet, a blister copper furnace 50 x 70 feet, a cupola building, warehouse, laboratory and assay office, machine shop, boiler house and three mineral houses, these latter being for storing the mineral as it comes from the mills. The three buildings have a storage capacity of about 18,000 tons, and one has recently been completed. Mineral from stock is shipped by water to the smelter at Buffalo, enough being so shipped, during the season of navigation, to keep the eastern plant running steadily for the entire year. As a rule the richer grades of mineral are shipped east and the lower grades smelted at Lake Linden, thus saving transportation charges on a considerable amount of worthless gangue contained in the lower grade mineral. At the Lake Linden plant there are two wharves, with storage capacity for coal and limestone, refined copper awaiting shipment, etc.

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The Buffalo plant is on the banks of the Niagara River, and is very complete. The rapid growth of this plant has brought about the complete building over of the original tract, and additional frontage to the north was recently purchased, while yet other contiguous parcels of land are under option and will undoubtedly be bought in the near future. A new electrolytic plant is now being built at that point, this being intended for the reduction of the grades of mineral carrying considerable values in silver. The saving in silver alone will soon pay for the cost of the plant, though the electrolytic copper will necessarily sell at about ¼ cent per pound less than the copper secured by smelting.

At the stampmills and smelting plant on Torch Lake there are extensive boiler houses, machine shops, blacksmith shops, carpenter shops, barns, electric plants, etc.—practically a duplicate of the list of miscellaneous buildings at the mine, though as a rule upon a smaller scale.

The company owns and operates the Torch Lake canal, charging tolls on all marine traffic passing through. Torch Lake connects with Portage Lake, which is in turn an arm of Lake Superior. The sluggish stream connecting the two lakes has been deepened into a canal full 21 feet in depth from end to end, and capable of accommodating the largest vessels plying the great lakes.

A sawmill is being built at the head of Torch Lake, near the mouth of the Trap Rock River. The company has recently purchased a large tract of standing timber and a sawmill at Whitefish Point, Chippewa County, Mich., on Lake Superior. Extensive purchases of standing timber elsewhere in this state and Wisconsin have also been made during 1900.

The project of constructing steel steamers for carrying mineral between South Lake Linden and Buffalo is under consideration.

The company has a series of large wharves at Lake Linden, with docks dredged out to at least 21 feet in depth fronting thereon. Frequent dredging is required, though the sand filling in from the mills is easily and cheaply moved.

The company has a series of very large coal sheds at Lake Linden. The sheds built during the past few years are of steel, fitted with the latest devices for unloading vessels, and supplied with electric lights, etc. The second half of a shed having a storage capacity of 200,000 tons of coal is now being completed. The company has ample storage room for enough coal to guard against any possible interruption to production from coal strikes or other troubles. Coal is the life blood of the mine, which now has engines with a combined capacity of nearly 50,000 horsepower—as much power as is now being generated by the great electric plant at Niagara Falls, and about equal to the power used in an average manufacturing city of 200,000 people.

The Calumet & Hecla maintains a hospital for its employees, with a staff of nearly a dozen physicians, of which Dr. E. H. Pomeroy is the

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chief. A fine new hospital was built in 1898 and fitted with the best laboratory and surgical apparatus procurable in Europe and America. It is called by competent judges one of the best and most complete hospitals in the country.

Early in its history an Employee's Aid Fund was instituted, into which the employees of the company paid 50 cents per month each, the company giving an equal sum, and from which fund disability benefits were paid in case of accident or sickness, and death benefits given the heirs of deceased members. This fund soon accumulated a surplus, which was invested by the trustees in the stock of the company. The fund now amounts to several hundred thousand dollars in value, and employees for several years past have paid nothing toward its maintenance, though receiving the same benefits as formerly.

The company owns more than 1,000 dwellings, which are rented to employees at an average of 6 per cent interest on the actual investment, above the cost of maintenance. Upwards of 1,000 dwellings are owned by employees on lands leased from the company at a low yearly rental. On leaving the employ of the company, the owners of dwellings on leased lands may sell to other employees, sell to the company, or remove their buildings to other lots. Like Ohio office-holders, "few die and none resign," among C. & H. employees, and jobs are handed down from father to son, so that the transactions in houses on leased lands are not numerous.

There are nearly 30 churches on Calumet & Hecla lands, all of which have been aided in erection and many in maintenance by the company.

The Calumet & Hecla maintains three independent systems of waterworks, one at Lake Linden and two at Calumet. One of these latter furnishes water from dams, for fire protection; the other pumps potable water from Lake Superior, four miles distant and 600 feet below the level of the mine location. The pumps at the Lake Superior plant are capable of raising about 4,000,000 gallons daily to a height of 600 feet to the mine location. At the dam and mine there are six pumps, with a combined daily capacity of upwards of 30,000,000 gallons. The combined capacity of the pumps at the various water works of the company, excluding the mammoth pumps at the stamp mills, is equal to the pumping capacity of any but a few of the very largest cities in the country, while the Calumet & Hecla company probably owns pumps of greater daily capacity, including its mine pumps, mill pumps and water works pumps, than any other corporation in the world, with the possible exception of the city of Chicago.

The present force employed by the Calumet & Hecla is upwards of 5,000. When the amygdaloid mine is well opened and producing largely, it is probable that the force will reach 7,000, and this by no means reaches the possible capacity of the mine as an employer of labor.

The company owns a hotel, at Calumet, and there are eight schools on its lands, many of which were built by the corporation.

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The company has a large stone building, used as a club-house for its employees, containing bathrooms, bowling alleys, etc. A library of about 25,000 volumes is maintained for the free use of employees. This library contains books printed in more than a score of languages. thirty different nationalities being represented among the employees of the corporation. A club and library building is now being built at Lake Linden.

The mine is opened for eight to ten years ahead of immediate requirements, about fifteen miles of shafts and drifts being opened ahead of the stopes.

The only thing that the Calumet & Hecla lacks is a street car line. Where its first mining work was done, in the virgin forest, in ground undisturbed since the days of the Mound Builders, there now stands a rapidly growing city of 33,000 souls. Where solitude reigned on the shores of Torch Lake when its first stampmill was planned, there now exists a population of 8,000 busy and prosperous people. Greater Calumet, of which the Calumet & Hecla is the heart, is three miles wide by eight miles long, and the most populous mining camp in the world at the present time.

TAMARACK.

The Tamarack Mining Company is incorporated under the laws of Michigan, with 60,000 shares, all issued, of the par value of $25 each. Albert S. Bigelow is president and W. J. Ladd secretary and treasurer. The directors are A. S. Bigelow, Joseph S. Bigelow, W. J. Ladd, J. Henry Brooks, Leonard Lewisohn, Edward S. Grew and Wm. E. Parnall, of Michigan. The main office is in the Sears Building, 199 Washington street, Boston, Mass. Annual meetings of shareholders are held on the first Thursday of May in each year. Local officials at the mine are Wm. E. Parnall, superintendent; Wm. E. Parnall Jr., assistant superintendent; John T. Reeder, Clerk; Thomas Maslin, mining captain; Chas. H. Krause, mill superintendent.

The Tamarack is one of the most interesting as well as the second largest mine of the district, and no property has greater possibilities of growth in the future. In point of production the Tamarack is now almost precisely where the Calumet & Hecla stood a quarter of a century ago. It has taken the Tamarack fifteen years to attain a position gained by the Calumet & Hecla in ten, but the achievement of the newer mine is in reality the greater, for the Calumet & Hecla found its mine at grass roots, whereas the Tamarack was compelled to go down 2,270 feet for its uppermost paying copper measures, and is now sinking a shaft which should make the company a Christmas present of the Calumet conglomerate at the enormous depth of approximately 4,750 feet.

The Tamarack mining tract consists of 1,120 acres, in Sections 10, 11, 14 and 15, Town 56 North, Range 33 West, in addition to which there are large areas of timber land, mill frontage on Torch Lake, dock

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frontage on Portage Lake, etc. The Tamarack mine tract is of very irregular outline, and is bounded on the north by sundry undeveloped mineral lands, on the east and south by the Calumet & Hecla mine, and on the west by undeveloped lands of the same corporation. The first mining was done in the southeast corner of the northwest quarter of the southwest quarter of 14–56–33. The Tamarack owes its inception to the late Capt. John Daniell, whose genius was not properly appreciated until a short time before his death, which was brought about by a disease of the brain due to his incessant mental labors. Twenty years ago Capt. Daniell was in charge of the Osceola mine, which had whetted its appetite on a few acres of rich conglomerate of the Calumet lode, only to find the balance of the reef lean on Osceola grounds. He hungered for more of the same rich rock, and noting the regular dip of the conglomerate at 37½ degrees, conceived the plan of opening a mine on the underlay of the lode, beyond the Calumet & Hecla's western boundary, by means of vertical shafts. These lands should have belonged to the Calumet & Hecla, but were held at what was then considered a high figure. It was not dreamed that an attempt would be made to develop them on the plan later carried into execution, and they were therefore thought to be of little value to anyone but the Calumet & Hecla, which could have opened the lode thereon by means of its incline shafts following the dip of the lode from surface. Capt. Daniell spent much thought upon the perfection of his plans and was able, only after several years of effort, to interest his principals in the undertaking. Eventually Messrs. Bigelow and Clark of the Osceola, with a few of the other large shareholders, furnished the necessary capital, amounting to about a quarter of a million dollars, and the lands were bought and the sinking of No. 1 Tamarack shaft begun in 1882.

In this day of mile-deep shafts, the magnitude of Capt. Daniell's undertaking cannot be readily appreciated. He was regarded as half-cracked by the majority of people; but lived to see the verification of his every prediction, and the opening of one of the greatest mines of the world along his plans. The shaft was bottomed in 1885, three and a half years after starting, and struck the lode at a depth of only 10 feet greater than the estimate of Capt. Daniell, made before the first sod was cut for the sinking of the shaft. The lode was rich, and from that time the history of the Tamarack is one of steady growth and large profits. Upon Capt. Daniell's breakdown, six years ago, he was succeeded as agent by Capt. Wm. E. Parnall, who had been his able lieutenant for many years, and who has proven a highly resourceful and successful manager of important mining interests, and has ably dealt with unusually complex and difficult questions.

Production, dividends, assessments, etc., of the Tamarack will be found in the statistical section of this volume. For the year ending Dec. 31, 1899, some of the more important figures were as follows:

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Gross receipts	$2,952,098.91
Gross costs	2,211,588.30
Net earnings	740,510.61
Dividends paid	600,000.00
Surplus for year	140,510.61
Surplus Dec. 31, 1898	893,717.49
Surplus Dec. 31, 1899	1,034,228.10

The Tamarack company had a deposit of $106,989.90 in the Globe National Bank, of Boston, when the latter failed, in December, 1899, on which there will be some loss, but not sufficient to seriously affect the company, in view of its handsome earnings and large surplus.

One item of the assets is $288,633.62 for wood and timber lands. While this is not exactly a quick asset, it is a valuable one and productive of profit to the company, owing to the steady appreciation of stumpage in the Lake Superior district. There is also an item of $132,000 for stock of the Lake Superior Smelting Company, which is now controlled by the Tamarack and Osceola companies. The financial showing of 1899 is much the best made for years. It could have been rendered even better had the construction account at the mine been entered separately, but the latter has been charged direct to working expenses. Construction work for 1899 aggregated $400,651.91, of which $187,464.81, or nearly half, went into No. 5 shaft and its equipment, the principal items of the outlay at No. 5 being $97,147.55 for actual underground work; $69,791.81 for the hoisting plant, and $18,204.91 for the boiler house and equipment. Other heavy items of expense in construction work were $60,016.98 for a condenser, compressor and sundries at Nos. 3 and 4, the North Tamarack shafts; $65,498.02 was expended for the new water works at Lake Superior; $30,058.97 for the extension of the coal sheds and wharf at Dollar Bay and $46,676.53 for electric light plant, new pump and water supply at the mills. The construction expense for 1899 was nearly double that of 1898, when work was confined largely to the sinking of No. 5 shaft, but the net earnings were larger in 1899 than for many years previously.

For the year 1899, opening work in shafts and drifts was done to the extent of 13,206.4 feet—over two and a half miles. Of the drifting 5,296 feet, or 16 feet more than one mile, was done on the Calumet conglomerate, and 1,887.9 feet was done on the Osceola amygdaloid. The crosscutting at the three working shafts amounted to 3,660.5 feet. Owing to the system of vertical shafts necessitated by the cupriferous beds carrying no outcrops on Tamarack lands, long crosscuts are required at the various levels above and below the points of intersection of shafts and lodes. Sinking for the year 1899 amounted to 1,065.5 feet, of which 147.5 feet were sunk in No. 2 shaft and 918 feet in No. 5 shaft.

The amount of rock broken in the mine during 1899 was 775,532

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tons, of which 631,090 tons were stamped. The mineral obtained for the year was 31,713,752 pounds, and the refined copper amounted to 18,565,602 tons. This would give a ratio of a little over 58 per cent of ingot copper to the ton of mineral. The figures do not match, and it is probable that the Tamarack company made more mineral during the year than was smelted, as it is manifestly out of reason that the mineral made at the Tamarack mills gave only 58 per cent of ingot copper. The percentage of ingot in the Tamarack mineral formerly ran from 65 to 70 per cent, according to whether dressed high or low at the mill. The Calumet & Hecla mineral, made from the same conglomerate, averages about 67 per cent ingot. In addition to the mineral made from the conglomerate, the Tamarack also mines a considerable amount of stamp rock from the Osceola amygdaloid, which gives mineral averaging better than 80 per cent ingot. As it is manifestly impossible to reconcile the statement of mineral produced in 1899 with the returns of ingot copper, no comparison of percentages of ingot per ton of rock can be given, and the only inference to be drawn from the discrepancy between returns of mineral and of ingot is, that a considerable amount of mineral produced in 1899 was not smelted that year and will be shown in the returns for the year 1900, when given.

According to the sworn statement returned to the State of Michigan by the Tamarack company, the following figures show the condition of the company on Dec. 31, 1899:

Amount of cash paid in on capital stock...	$ 450,000.00
Amount paid in by conveyance of property	330,000.00
Amount invested in real estate.	200,686.00
Amount of personal estate.....	1,498,436.62
Amount of floating debt.....	464,208.52
Amount due corporation.....	.....

The Tamarack mine is opened on the underlay of the Calumet conglomerate reef, and to some extent upon the Osceola amygdaloid as well, the latter being opened by means of crosscuts run east from the openings on the conglomerate. The amount of stamp rock broken from the conglomerate in 1899 was 580,000 tons, and from the amygdaloid 51,090 tons. The mine is opened by means of four shafts, with a fifth shaft now sinking and very nearly to the lode. Shafts 1 and 2 are in the extreme southeast corner of the Tamarack lands, nearest to the outcrop of the conglomerate and consequently get the lode at the least depth, amounting to about 2,270 feet in the case of No. 1 and a little greater depth in No. 2. Shafts 3 and 4 are known locally as the North Tamarack, No. 4 being about one mile north and between an eighth and a quarter of a mile east of the southernmost shaft. Of these shafts, Nos. 1 and 2 have been the richer producers, and have made the greater part of the millions in dividends paid by the Tamarack from the rock underlying barely forty acres of ground, Nos. 3 and 4 are very deep shafts, and proved very disappointing when

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bottomed in 1894. The lode is wide at that point, but much below the average richness maintained in the Calumet & Hecla workings and in the southern shafts of the Tamarack. No 4 shaft has not been deepened since bottomed early in 1895, but No. 3 has been opened extensively, and while carrying much less copper per fathom of ground than the lode gives to the southward, the width of the reef and the large scale of production have rendered it decidedly profitable to the Tamarack company. No. 4 is connected underground with No. 3 and is valuable for ventilation and safety to miners in case of an accident to No. 3. One great advantage of vertical shafts, offsetting in some measure their greater expense of operation, is found in their accessibility in case of fire. When a vertical shaft becomes ignited it is possible to flood it from top to bottom with streams of water that reach every square foot of timbering. The Tamarack as well as the Calumet & Hecla, has had experience with mine fires, and that the Tamarack has escaped so cheaply may be ascribed in a measurable degree to its having vertical shafts.

The depths of the various Tamarack shafts, on Dec. 31, 1899, was as follows:

No. 1	3,240 feet.
No. 2	4,013 "
No. 3	4,596 "
No. 4	4,450 "
No. 5	3,918 "

At the present writing, Nov. 5, 1900, No. 5 shaft is almost exactly 4,700 feet in depth, and it is now expected that the conglomerate lode will be cut on or about Christmas day. Should it prove as rich as there are many reasons for thinking it will be shown, there could be no more acceptable holiday gift for shareholders. If the lode is rich at the bottom of this shaft, the future of the Tamarack will be assured for a generation to come, and untold millions will be added to the value of the mine. The finding of the lode lean at Nos. 3 and 4 shafts, six years ago, was disappointing but scarcely surprising, whereas the finding of similar conditions at the bottom of No. 5 shaft would prove a great surprise, as well as a keen disappointment. There is no absolute certainty in a mine, beyond the limits of actual development, but there is no known mineral bed in the world so regular in its characteristics as the Calumet conglomerate, and few of which so much is known and of which so much can be definitely predicated. The copper courses in the Calumet & Hecla are making toward No. 5 Tamarack—in fact the location of that shaft was determined only after very careful consideration of all the surrounding conditions. The anticipation of a fine showing on the conglomerate where it is to be cut by this shaft within the next few weeks is based on both evidence and logic.

No. 5 shaft was started in August, 1895, after the bottoming of

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No. 4 shaft at the North Tamarack. When completed it will be much the deepest shaft in the world, and is now exceeded in depth only by the Red Jacket vertical shaft of the Calumet & Hecla, with No. 3 Tamarack a close third and No. 4 Tamarack in fourth place, giving to this mine possession of three of the four deepest mining shafts of the world. The sinking of No. 5 has been remarkably expeditious—much the fastest work of the sort ever done, despite a number of adverse conditions, prominent among which was an excessive inflow of water during the first two years. The record of 918 feet sunk in the year 1899 is one of the best ever made, and highly creditable to the management that planned and directed, and the skilled miners who executed the work. No. 1 Tamarack required 3½ years to sink 2,270 feet, and the Red Jacket vertical of the Calumet & Hecla took nine years in descending 4,900 feet. The time required in sinking No. 5 Tamarack, from the cutting of the first sod, in August, 1895, will be about 5½ years, barring accidents, for a depth of 4,750 feet.

In the way of equipment the Tamarack stands second only to its older neighbor, the Calumet & Hecla, among the great mines of the globe. The machinery at Nos. 3 and 5 shafts is especially massive, though the equipments at the older shafts are small only in comparison with the newer machinery for the deeper shafts. At No. 3 there is an enormous double conical drum, having a diameter of 13 feet 6 inches at either end, with a diameter of 36 feet 9 inches in the center. The cable winds over these drums on specially built-up runs of steel, affixed to the perimeter of the drum. This machine was built by the Allis works, of Milwaukee, and was installed in the fall of 1895. This hoist has raised a ten-ton load vertically at the rate of 55 miles an hour, and running at that speed has been checked to a dead stop between two levels, in a distance of 75 feet. It is a beautiful piece of machinery and as useful as it is handsome. The hoisting is done in counterbalance, as at practically all of the vertical shafts of the district.

At No. 5 shaft one of the finest engines ever constructed has recently been placed in position, in a brownstone engine house which is in harmony with the masterpiece of mechanical ingenuity it houses. The drums in this hoist are among the largest ever constructed, having a diameter of 25 feet, and are capable of holding 6,500 feet of 1¼ inch steel cable. There are four high-pressure cylinders, each 34 inches in diameter and of 72-inch stroke.

Work was begun in October, 1900, on the new combination shafthouse and rockhouse at No. 5, which will have but one rival in size and capacity, that being the giant at the Red Jacket vertical. This building will be of steel throughout, 62 x 104 feet on the ground and 112 feet high to the headsheave. Steel buildings cost more than wooden ones, but they last longer and afford immunity from fire, which is always a menace to life and property. The rockhouse will be fitted with 8 crushers of the reciprocating jaw type, and the necessary grizzleys, bins, etc. Power

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will be supplied by a compound Corliss engine having high and low pressure cylinders 10 and 18 inches diameter, with 24-inch stroke. There will be room in the building for eight more crushers, doubling the initial capacity. The shaft itself is 7 feet 2 inches by 27 feet in size, inside of timbers, and contains five compartments, four of full working size for hoisting, and one division for ladders, air and water pipes, and electric wires. The shaft is built for heavy work, and will be capable of large production—in fact it should eventually bring about the doubling of output by the mine, if it proves reasonably rich. Four levels will be opened above the point of intersection, between the shaft and the Calumet & Hecla boundary line, and as many levels will be run below as may be required. Crosscuts for these upper levels are now being driven. Connection with No. 2 shaft, to the south, will be secured by a drift now being driven on the 28th level, and presumably at a number of points deeper, later on, as the territory tributary to the new shaft is opened.

The improvements at No. 5 include a boiler-house with a fine battery of boilers and two self-supporting steel smokestacks, each 115 feet high and lined with firebrick. A new compressor house, 57 x 75 feet in size, is being built, and will contain an Ingersoll-Sergeant two-stage cross-compound air compressor of 40-drill capacity. Later on a second and more powerful compressor of the same make will be installed. The first compressor has 18 x 34-inch steam cylinders, of 36-inch stroke, and the larger compressor will have steam cylinders 19 x 53 inches with 48-inch stroke, and three pairs of two-stage air cylinders, each 18 x 27 inches and of 48-inch stroke. The two-stage compressors reduce the air at two separate operations, a considerable degree of economy being secured by dividing the operation into two periods.

A new fan was installed at No. 3 shaft in the winter of 1899–1900, replacing one of much smaller capacity. It is 10 feet in diameter, with blades 3½ feet wide at the perimeter of the fan, and it can drive 192,000 cubic feet of air per minute to the depth of the shaft, nearly a mile, and force the foul air out of the openings, requiring 60 horse power to run. The fan not only ventilates the mine, supplying fresh air for the miners and driving out the dead air laden with the fumes of dynamite, but also aids materially in reducing the temperature, which otherwise would be about 80 degrees in the bottom of the mine.

A new auxiliary hoist was installed at No. 3 shaft in June, 1900. This is used for handling mine employees and for lowering timber, drill steel, etc. It is a duplicate of the hoists recently installed at Nos. 5 and 6 Osceola, and at the Isle Royale mine, being a 32 x 72 duplex, with 72-inch stroke. The drum is 18 feet 6 inches in diameter and the grooves for the cable are all lathe-turned.

The water pumped from the mine contains dilute sulphuric and hydrofluoric acids, and is very destructive to the boilers, water for which is now secured from Lake Superior, a new and comprehensive system of waterworks for the mine and mine location having

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recently been completed. The water is pumped through a 10-inch steel main from the shore of Lake Superior, five miles northwest of the mine, the elevation being nearly 700 feet. The plant has a Nordberg duplex pump guaranteed to raise 1,000,000 gallons daily, which can deliver nearly 50 per cent more water than its rated capacity. On the shore of the lake a shaft was sunk to the depth of 40 feet, and a tunnel driven from the bottom to a distance of 480 feet under the bed of the lake. There is a depth of about 35 feet of water above the intake, securing immunity from needle and anchor ice in winter. At the mine, the water is delivered into two immense steel tanks, located on the highest point of ground on the Tamarack lands, these two tanks having a storage capacity of 200,000 gallons, and the larger being 65 feet in diameter by 42 in height. From the tanks the water is distributed into mains for the use of the Tamarack and Osceola mines; for the use of the families living on the company lands, and for fire protection. The pumping plant is one of the best ever built, and a model in every respect. The most remarkable feature of the entire plant is that the cost of operation does not exceed $10 per day, including fuel and wages.

Among the improvements now under way is a $30,000 hospital for employees, which will be among the best to be found anywhere. The building is 60 x 60 on the ground, two stories in height, with large basement and an attic story, all of which will be finished. The basement and first floor are of selected Lake Superior redstone, upper story and attic of frame. The stone work is completed and the superstructure well along at this writing. Interior finish will be of selected Georgia quarter-sawed pine, oiled. The building will contain emergency wards operating rooms, dispensary, a sun veranda, and all the conveniences afforded by the latest and most modern city hospitals, including elevators and a system of indirect steam heating, by which warm air will be constantly supplied every room in the building from the ceiling and the foul air drawn off from the level of the floor. The equipment will be as complete as money and experience can secure, and when completed the new Tamarack hospital will stand as a permanent monument to the management of the company, and a refutation of the adage that corporations have no souls.

Within the past few years the Tamarack has expended vast sums at its mills and docks, as well as at the mine. These costs are incidental to expansion, and will continue as long as the mine grows, which will be for many years to come. When a Lake Superior mine ceases spending money on new work, it starts to decay. A liberal portion of the annual earnings must be put back into the mine and into new machinery and building, or the mine will soon fall behind; its costs of mining and milling will stand still, or even increase, and the end of the road is suspension, reorganization or failure. Stockholders unacquainted with the actual conditions may grumble at the heavy charges for new work, but a big construction account is a healthy sign at a copper mine.

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It means a continuance of dividends during the period of depression which must ultimately come in the copper industry, though at present that day seems far in the future.

The mills, two in number, are located on Torch Lake, a little more than a mile south of the Calumet & Hecla mills. They contain seven stamps, with a daily capacity of upwards of 2,500 tons of conglomerate rock. A pump of 40,000,000 gallons daily capacity, second only to the pumping engine "Michigan" at the Calumet & Hecla mills, supplies water, through a tunnel, to both the Tamarack and Osceola mills. A change in the size of the screens now in use has been decided on, and will soon be made, which will add to the efficiency of the stamps. Excellent results are being secured in the way of low costs and small losses of metal in the waste sands. For the year 1899 the cost of milling each ton of rock stamped was 22.727 cents. So far as known, this is the low record for milling made on conglomerate rock, which is much more refractory than the amygdaloids stamped by all other mines except the Osceola and Calumet & Hecla. The cost of milling was 47.49 cents per ton, just ten years previously, in 1889. By this reduction in the cost of stamping and washing, of over 50 per cent, amounting to almost exactly 25 cents per ton, the Tamarack saved upwards of $150,000 in 1899. There is no other branch of the copper industry where such rapid progress has been made, and such remarkable savings effected in the last decade, as in the milling.

The control of the old Lake Superior Smelting Company has passed into the hands of the Tamarack and Osceola corporations. The Lake Superior company has furnaces at Hancock and at Dollar Bay, but the latter works being nearer to the mills, as well as more modern, the Tamarack mineral is all smelted there, J. J. Case being superintendent of the smelter. The smelting costs are not obtainable, but are probably well under $5 per ton, or ¼ cent per pound. Mr. Case is not only an experienced man, understanding the practical and theoretical processes of smelting, but is fertile in ideas withal, and has introduced many improvements which have greatly reduced the costs of handling the mineral and copper, as well as simplifying the work and adding to the productive capacity of the plant.

The works of the Tamarack-Osceola Copper Manufacturing Company are also located at Dollar Bay, but this concern has no official connection with the Tamarack or Osceola mines, being a close corporation in which the stock is held mainly by a few large shareholders of the mines named. The Tamarack-Osceola Manufacturing Company makes wire and sheets from copper bought of the two mines.

At Dollar Bay the Tamarack and Osceola companies have their wharves and coal sheds. These were formerly on Torch Lake, at the stampmills, but the Torch Lake canal being owned by a private corporation, the tolls, which ranged from 10 cents per ton on coal to 50 cents per ton on package freight, amounted to a considerable charge, and when new wharves and sheds became necessary, six years ago, a

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change of base was made to Dollar Bay, which is four miles southwest of the mills and located on Portage Lake, where the channels are free. In addition to substantial wharves for general purposes, the companies own a mammoth coal shed, built in 1895 and which has since been repeatedly enlarged as the growth of the mines required the provision of greater fuel supplies. The latest additions comprise a lengthening of the dock and wharf in 1899, and an addition of 160 feet to the coal shed in the summer of 1900. The sheds are provided with every facility for the unloading of coal cargoes from vessels which lie alongside, and inside are furnished with electric lights, conveyors and numerous railroad tracks. Considerable trouble having been experienced from spontaneous combustion at this and other large coal sheds of the district, the Tamarack has a steam-shovel and piles its coal so that in case of fire the burning section of coal can be cut out on short notice, and the loss confined to small proportions.

OSCEOLA.

The Osceola Consolidated Mining Company has its principal office at 199 Washington street, Boston, Mass. A. S. Bigelow is president, W. J. Ladd secretary and treasurer, and the directors are Messrs. A. S. Bigelow, Edward S. Grew, W. J. Ladd, Leonard Lewisohn, J. Henry Brooks, Joseph S. Bigelow and Wm. E. Parnall, of Michigan. Annual meetings are held on the second Thursday of March. The company is incorporated under the laws of Michigan, with a capitalization of 100,000 shares, of which 93,000 shares are issued. The number of shareholders of record of the corporation on Dec. 31, 1899, was 1512.

Local officers of the company are Wm. E. Parnall, superintendent; Wm. C. Watson, assistant superintendent.

The Osceola Consolidated comprises four separate and distinct mines, none of which are connected or connectible, as none of the four touch corners at any point. These mines are the Osceola, Tamarack Junior, Kearsarge and South Kearsarge, the latter being a new mine, in process of opening.

The Osceola proper has 720 acres, with a mile north and south on the Osceola amygdaloid lode, giving one and one-fifth miles of the strike of the lode, which is approximately North 39 degrees East. The neighbors of the Osceola proper are the Calumet & Hecla on the north, Laurium and Tecumseh on the east, Tecumseh on the south, and unimproved mineral lands on the west.

The Tamarack Junior is a tract of 120 acres in 11–56–33, one-quarter mile wide and three-quarters of a mile long from north to south, sandwiched between the Centennial on the east and the Calumet & Hecla on the other three sides. It was originally a portion of the Tamarack, but was set off about ten years ago as an independent mine, and opened by means of two vertical shafts. In 1897 it was absorbed by the Osceola Consolidated. It works the Calumet conglomerate, of which it has a small area of very richly mineralized ground. It is unlikely, in view

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of the developments on the same lode in the Centennial to the east, that the northern end of the property will prove of much value.

The Kearsarge mine, also absorbed by the Osceola in 1897, has 1,120 acres of land on the mineral belt, in Sections 5 and 6, Town 56, Range 32, and in Section 1, 56–33. The Allouez and Ahmeek lie to the north, undeveloped lands to the east, Mayflower and Wolverine to the south, and undeveloped mineral lands to the west. This mine is opened exclusively on the Kearsarge amygdaloid.

The South Kearsarge, formerly known as the Iroquois, consists of 160 acres, the southwest corner of Section 7, 56–32. It has the Wolverine on the north, Mayflower on the east, Old Colony on the south, and Centennial on the west. Work was begun at this point late in the year 1899, when the developments at the Kearsarge shaft of the Centennial, coupled with the rich ground opened in the Wolverine to the north, rendered it reasonably certain that the Iroquois tract possessed a very valuable section of the Kearsarge amygdaloid. The mine is not a producer, except as a little rock is taken from the shafts and drifts opened, but is sinking two shafts 1,100 feet apart, in good ground, and within a couple of years will be heard from prominently. Owing to its having everything needed in the way of transportation and milling facilities, the South Kearsarge can begin making copper just as soon as the ground is opened sufficiently to allow stoping to advantage.

The following items regarding the Osceola mine are taken from the annual report to shareholders dated Dec. 31, 1899:

Gross receipts of year	$1,791,471.01
Gross expenditures	1,256,638.72
Net income for year	$ 534,832.29
Dividends paid in 1899	558,450.00
Deficit for year 1899	$ 23,617.71
Expenditures account construction	190,231.27
Receipts from sale of treasury stock	32,787.96
Balance of assets Dec. 31, 1899	546,867.85

The items of construction account, a portion of which account was charged to operating expenses and a portion to the special fund provided for construction, were as follows:

For new stamp mill	$ 98,529.96
Sinking South Kearsarge shafts	19,105.84
Sundry construction at Kearsarge mine	43,975.27
Sundry construction at Osceola mine	26,527.43
Sundry construction at Tamarack Junior mine	2,092.77
Total	$190,231.27

It is stated in the annual report that the advances in wages and

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material added one cent per pound to the cost of making copper for 1899.

On Dec. 31, 1899, the surplus fund of the company amounted in value to $870,227.88, and liabilities to $323,360.03, leaving a surplus of $546,867.85. The surplus account contains an item of $60,000 for stock held in the Lake Superior Smelting Company and $75,000 for stock held in the Hancock & Calumet Railroad, also an item of $48,737.91 for wood and timber lands. The Osceola company had a deposit of $115,974.37 in the Globe National Bank, of Boston, when that institution failed in December, 1899, on which there will be a considerable loss.

The following items regarding the company are taken from the sworn statement returned to the State of Michigan, under date Dec. 31, 1899:

Amount of cash paid in on capital stock...	$ 480,000.00
Amount paid in by conveyance of property	1,855,000.00
Amount invested in real estate.....	1,321,221.47
Amount of personal estate.....	870,227.88
Amount of floating debt.....	323,360.03
Amount due corporation.....	.....

The Osceola company was organized in 1873, by E. J. Hurlbut, to work the southern extension of the Calumet conglomerate. Six shafts were sunk on this lode by the Osceola, but only one, located near the Calumet & Hecla line, proved profitable. In 1877 attention was turned to the underlying amygdaloid, and after many vicissitudes the Osceola has finally become one of the great and profitable mines of the district, with prospects of yet greater growth in the future. There are six shafts on the amygdaloid, numbered from north to south, of which the two northernmost, Nos. 1 and 2, are abandoned. No. 3, the northernmost active shaft, has 3 compartments and is about 3,000 feet deep. No. 4 is 600 feet southward and of the same size, about 3,700 feet deep. No. 5 is 1,300 feet south of No. 4 and is 3,600 feet deep. No. 6, (or "Opechee") shaft is the southernmost of the mine, being 1,300 feet south of No. 5, and a little less than 4,000 feet in depth. This is the newest and best shaft of the mine. It is also the most productive and in the best ground at present. There are good equipments at the older shafts, but the best machinery is at Nos. 5 and 6, which are fitted with Nordberg hoists good for a depth of 6,500 feet, similar to the auxiliary hoist recently installed at No. 3 Tamarack. The hoist at No. 5 went into commission in the spring of 1900. The mine is supplied with all the usual machinery in the way of compressors, etc. Water is brought from Lake Superior by the Tamarack water works.

Crosscuts have been sent to the Calumet conglomerate from a number of points in the Osceola, but without encouraging results. A discovery made about two years ago has added materially to the revenues of the corporation. At many points in the mine the footwall

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carries copper in considerable quantities, in the form of barrel work and masses. This occurrence is not regular, but where such patches of mineralized footwall are met with, the copper is secured at minimum cost.

The Tamarack Junior is earning money for the consolidation, but as little as possible is being expended there in return. Good bunches of ground are cut off by the boundary lines, and unless there are discoveries of new productive ground not looked for at present, the mine has but a few years of existence before it.

The Kearsarge is one of the growing members in the Osceola partnership. It is connected underground with the Wolverine, and the Kearsarge and Wolverine recently traded ground to the extent of about 13½ acres. This was mutually beneficial, giving each property a chance to follow its copper according to the dip of the lode instead of by the section, near the boundary line. A new shaft, No. 3, is being sunk at the Kearsarge. It is 1,500 feet north of No. 2, and has 3 compartments. It is being fitted with a Nordberg hoist similar to those at Nos. 5 and 6 Osceola and at several other mines of the district, the hoist being good for 6-ton loads to a depth of 6,500 feet. A new man-car has been installed at No. 2 shaft, which is now down 2,400 feet.

At the South Kearsarge there are two shafts, down about 500 feet each. Work on these was started in September, 1899. They are fitted with old hoists, discarded from the Osceola, which are adequate for development purposes but must be replaced for profitable production. A rockhouse is being built at No. 1 shaft, to which the rock from No. 2 will be trammed on a trestle 1,100 feet long. Both South Kearsarge shafts are looking well and give promise of a large mine within the next two or three years.

The Osceola mills are on the shore of Torch Lake, adjoining those of the Tamarack. The old mill, which was built about fifteen years ago, when the Osceola was forced to leave Portage Lake, is of wood and has four heads. The new mill, which is 135 x 215 feet in size, has three stamps, while the newest mill, now building, will be a duplicate in all essential features of the second mill. In the new mill there are three stamps each with circular shoes and pistons 20 inches in diameter, having a 24-inch stroke. At 95 pounds steam pressure they strike 100 blows per minute and in a test have stamped 550 tons of rock each in a regular working day of 20 hours. The three are now stamping an average of 1,600 tons daily. They are run by a Nordberg Corliss engine with 12 x 36-inch cylinders and 36-inch stroke. These stamps are in many respects different from any in use heretofore, and are giving fully as good results as had been hoped for. The screens are circular and with openings ⅜ inch in size, or just double the former mesh, which was 3/16 inch. As a result much heavy copper that formerly clogged the mortar-boxes is now readily passed through the screens, and there has been no increase in the loss of fine copper in the tailings. At present the two Osceola mills contain the greatest variety

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of stamps and washing machinery to be found in the district, but the back numbers will soon be discarded. There are five varieties of stamp heads, three of jigs, and experiments are being conducted on the fine sands and slimes with a Wilfley table and a Bartlett concentrator. A new jig, which is the joint product of Supt. Krause and Capt. Parnall, is giving excellent results, and will probably replace all other kinds, there being upwards of 100 of the new variety in use in the mill at present.

The work of the new mill, which went into commission in November, 1899, was so satisfactory, and the results in such contrast to the work of the old mill, that a second new mill was immediately decided on and work on the foundation begun in the summer of 1900. The new mill will be practically a duplicate of the mill opened in 1899, but will have room for four heads. It should be in commission before the close of 1901, when the old wooden mill will probably be closed.

A new boiler house, with capacity to furnish 3,000 horse power will be erected and equipped in 1901, at the rear of the new mills.

A Fraser & Chalmers Corliss engine runs a 100-kilowatt generator which furnishes electric light for the mills and allied buildings.

The Tamarack and Osceola mills have been connected by a tunnel running parallel with the lake shore, and which is fitted with a tramline.

The Tamarack and Osceola mills had 3 pumps, with a combined daily capacity of 35,000,000 gallons. It being probable that these would prove inadequate to the needs of enlarged production by the new mills, a 40,000,000 gallon pump was installed late in 1899. It is housed in a steel-frame building 35 x 70 feet, on the shore of the lake, and draws its water from Torch Lake through a tunnel 8 x 8 feet, which runs from the pump-house under the bed of the lake for a distance of 1,275 feet. The intake is by means of a large number of 3-inch holes drilled through the sandstone bottom of the lake, thus guarding against clogging with ice or drift. The pump itself is a triple-expansion Nordberg, with cylinders of 22, 40 and 60-inch diameter, and has three horizontal plungers 30 inches in diameter with 52-inch stroke.

The Osceola and Tamarack companies are under the same eastern and local management, and the article on Tamarack contains many references to the Osceola. By joining forces the two mines are able to do many things which it would be unwise for either to attempt singly—as for instance, the installation of the forty-million-gallon pump at the mills. The larger producer, all things being equal, will make the finished product at the lowest cost per unit. The combination between the Tamarack and Osceola lightens costs in a variety of ways and enables both mines to take advantage, collectively, of opportunities which could be availed of by neither singly.

The rock of the Tamarack and Osceola mines is hauled to the mills by the Hancock & Calumet railroad. This is a narrow gauge

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road which was built about twelve years ago, largely to handle this traffic, and which was aided by the purchase of stock by both mines. The road has lost its entity, being now a part of the Duluth, South Shore & Atlantic system. The mines think the transportation charges on their rock entirely too high, but have been unable to secure the reductions asked. They have consequently surveyed a line for a new road between the mines and mills, paralleling the Hancock & Calumet tracks in the main, which may or may not be built in 1901. As the new line would cost a great deal of money which the mines could use to advantage in other work, and its operation would much impair the earning power and value of the existing line, a mutually satisfactory settlement of the present differences is to be hoped.

TECUMSEH.

The Tecumseh Copper Company is organized under the laws of Michigan with 100,000 shares, of which 40,000 only have been issued, the balance remaining as treasury stock to furnish funds for the exploratory work of the company. H. F. Fay is president, W. B. Mosman secretary and treasurer, and the main office is at 60 State street, Boston, Mass. Jas. Chynoweth is Michigan director and superintendent.

The landed estate of the company consists of 560 acres in Sections 27, 32, 33 and 34, Town 56 North, Range 33 West. The property is very peculiarly shaped, having about a mile and a half on the outcrop of the Calumet and Osceola lodes and an east-and-west length of two and a half miles. It lies next south of the Osceola, and No. 6 shaft of the latter, which is the best of the mine, is barely more than a quarter of a mile north of the Tecumseh line. Lying east of the Tecumseh are the Laurium, Metalline and Torch Lake tracts, with undeveloped mineral lands on the other sides. In addition to the two lodes previously named, the Tecumseh has the Kearsarge and Pewabic amygdaloids, and probably others.

The present company is a reorganization of the Tecumseh Mining Company, which was formed in March, 1880. A great deal of work has been done on the property at various periods in the past two decades, but the Tecumseh has never been a producer. There is probably no property in the copper district on which so large an amount of money has been carefully expended that has shown so little copper for the work done. Shafts have been sunk to a depth of about 1,000 feet each on the Osceola and Calumet lodes, and have shown merely occasional patches of copper, and nothing on which any hope of profitable production could be reasonably based. The work done on these two lodes is of sufficient extent to satisfy those acquainted with the district that it is useless to sink deeper on them. It is possible that at great depth the Osceola might prove profitable, but the contingency is too remote to justify further expenditures in that direction. Developments at No. 6 Osceola, at great depth, may eventually indicate the advisability

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of sinking deeper on that lode on the Tecumseh lands, but this seems a possibility rather than a probability.

Attention is now being paid to the Kearsarge and Pewabic lodes. It is possible that these may show something of value. The work on the Tecumseh has not been done in a hap-hazard manner, but has been skillfully performed, and that nothing of value has yet been encountered is simply due to the lack of copper on the lands, so far as explored. There is good ground a short distance north of the property and again at a short distance south the Rhode Island is showing fairly well, though its developments on the Pewabic amygdaloid are by no means so rich as further south, in the Portage Lake district, where the Pewabic lode is very rich in the Quincy and Franklin mines.

The assets of the company, on Dec. 31, 1899, amounted to $72,546. During the year 1899 cash to the amount of $63,172 was expended on exploratory work, supplies and equipment.

The total expenditures on the Tecumseh, to date, have been about $250,000.

MAYFLOWER.

The Mayflower Mining Company was incorporated, under the laws of Michigan, early in 1899, with 100,000 shares of capital stock of the par value of $25. The officers are H. F. Fay, president; W. B. Mosman, secretary and treasurer; H. F. Fay, Manning Emery, John C. Watson, W. B. Mosman, Stephen R. Dow and Jas. Chynoweth of Michigan, directors. The main office is at 60 State street, Boston, Mass. Annual meetings are held on the third Wednesday in March, and there were 399 shareholders of record on December 31, 1899. Jas. Chynoweth is superintendent and James Biscombe mining captain.

The Mayflower tract consists of 840 acres, located in Sections 7 and 8, Town 56 North, Range 32 West. The Kearsarge mine lies to the north, Canal lands to the east, the Old Colony to the south and the South Kearsarge and Wolverine mines to the west. The entire area is on the mineral belt, the Eastern Sandstone lying approximately at the extreme southeastern corner of the company's lands, which are in a compact tract. As the Mayflower lies immediately north of the Old Colony, and each possesses the same mineral lodes, the tunnel now being driven across the formation by the latter named company is really of as much benefit to the Mayflower as to its owner. Reference to this tunnel will be found in the following article, on Old Colony. In addition to 840 acres of mineral land, the Mayflower owns a millsite on Torch Lake.

Actual exploratory work on the Mayflower tract was not begun until the spring of 1899, the unusually inclement winter preceding having prevented sooner starting to advantage. The work performed on this tract possesses much interest to mining men and to scientists interested in the geological problems of the district, as the Mayflower tract is one of the few virgin fields on the copper belt, despite its close

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proximity to developed mines. The tract probably possesses the northerly continuation of the Isle Royale and Portage lodes, and other cupriferous beds as well.

The first work on the Mayflower property consisted of cutting roads for the transportation of supplies, construction of boiler and engine house, a warehouse, boarding house and a half dozen dwellings. Fortunately the property is not far from Calumet, so that no unduly heavy charges have been incurred for building houses. As the field was a virgin one, Capt. Chynoweth decided upon trenching across the formation previous to attempting to locate shafts, which was obviously the proper course to follow. Trenches cut down to the rock were run to the extent of 1,570 feet during 1899, and resulted in cutting no less than four mineral beds carrying copper. What is supposed to be the Isle Royale amygdaloid was soon located. Three trenches were cut across this bed, at distances of 500 feet apart, and showed the lode to be quite uniform in width and characteristics, at surface. It is ten to twelve feet wide and shows the epidote so freely found in the Isle Royale mine, also the calcite and prehnite associated therewith. A shaft was immediately started on this lode and is still being sunk, with drifting on each level, as opened. The lode, as a whole, is not up to the richness shown on the Isle Royale property, though frequent patches of good copper-bearing ground are encountered. From the showing so far made on this amygdaloid it is difficult to express a definite opinion as to whether the lode would or would not pay to mill. It is, however, worth following. The copper seems to lie mainly near the hanging wall, where two feet of the bed is nicely mineralized, the balance being lean or barren as a rule.

The second shaft of the Mayflower is located close to the southern line of the company's lands, near the Old Colony boundary, though the lode has been traced, by means of trenches, for a quarter of a mile to the northward. This southern opening is known as the "Faull" shaft, and has shown better ground, as a rule, than the shaft to the north. At times some rock decidedly rich has been encountered in the Faull shaft, though considerable barren ground has also been cut. It is evident that the lode, which is an amygdaloid, is very bunchy. As to whether it will or will not pay to work, the answer rests on the proportion of rich ground found throughout the lode. The Mayflower is handicapped by reason of lack of accurate data regarding results from its lodes in mill practice. Most of the new mines have neighbors working the same beds elsewhere, and from their results opinions approximating the facts can be drawn. There are experts who can judge of the percentage of copper in a piece of stamp-rock—but it must be stamp rock with which they are acquainted. When it comes to estimating the amount of copper in rock from a new lode, one man's guess is about as good as another's. Some lodes make a brave showing with a small amount of copper, while others carry good values and give little indication of their wealth. Out of a dozen

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samples of average copper-bearing rock, a man unacquainted with the district would be apt to select the Calumet & Hecla specimen as about the poorest in the lot.

In addition to the two lodes noted, on each of which shafts are being sunk, there are at least two other cupriferous beds on the property, and probably several more. Lying about 100 feet west of the supposed Isle Royale lode there is another amygdaloid of about the same width and also carrying epidote and the associated minerals. The finding of the second amygdaloid at that distance to the west is strong circumstantial evidence that the lode first opened is really the Isle Royale, in which case the bed to the west would be the Grand Portage. The distance to the first lode from the underlying sandstone is about the same as at the Isle Royale mine, and the distance to the second, or Grand Portage epidote, is but little less than at the Isle Royale mine. Should a profitable mine be opened on the amygdaloid on which the first shaft is being sunk, the western lode lies so near that it could readily be mined by means of crosscuts run between the two.

About 750 feet west of the so-called Isle Royale there is a third amygdaloid carrying calcite and some epidote. The dip of the shaft being sunk on the epidote is about 40 degrees, while the Faull shaft pitches much more sharply. This is perhaps due to the near proximity of the latter lode to the Eastern Sandstone, which invariably causes a much sharper dip than is found further to the west on the mineral belt.

In addition to the amygdaloids there are several conglomerates located on the property, some of which may show something of value.

The following figures relating to the finances of the Mayflower company are of date Dec. 31, 1899, and are from the sworn statement returned to the State of Michigan:

Amount of cash paid in on capital stock	$800,000.00
Amount paid in by conveyance of property	.....
Amount invested in real estate	540,000.00
Amount of personal estate	208,502.15
Amount of floating debt	.....
Amount due corporation	.....

The project of consolidating the Mayflower and Old Colony companies has been discussed at various times during 1900. The plan offers certain advantages, one of which is that the money to be expended in exploring these properties would probably cover more ground were a consolidation effected.

About forty men are employed at the Mayflower at present.

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OLD COLONY.

This property is so closely related to the Mayflower, in location, management and general conditions, that the article on the last named mine should also be read in connection with the following paragraphs devoted to the Old Colony.

The Old Colony Mining Company was organized late in 1898, and begun work immediately thereafter. It is incorporated under the laws of Michigan, with a capitalization of $2,500,000, divided into 100,000 shares, all of which are issued. The number of shareholders of record on Dec. 31, 1899, was 598.

H. F. Fay is president; W. B. Mosman secretary and treasurer and Messrs. H. F. Fay, Wm. H. Reed, Edmund S. Clark, John C. Watson, Stephen R. Dow, W. B. Mosman and Jas. Chynoweth, of Michigan, directors. The main office of the company is at 60 State street, Boston. Jas. Chynoweth is superintendent and Thomas Rapson mining captain.

The real estate of the company consists of 1,200 acres of land, being all of Sections 17 and 18, Town 56 North, Range 32 West, except the south half of the southeast quarter of Section 18. About 1050 acres are on the mineral belt, the southeastern corner of the property overlapping on the Eastern Sandstone. For neighbors the Old Colony has the South Kearsarge and Mayflower on the north, the sandstone on the east, Canal lands and the St. Louis property of the Calumet & Hecla on the south, and the Calumet & Hecla on the west. The southwestern corner of the Old Colony is but a short distance from the village of Laurium, and in view of the rapid growth of Calumet, now the largest mining camp of the world—an assertion verified by the Federal census of June, 1900—a portion of the surface of the Old Colony may become quite valuable for building purposes in the near future. This is especially likely in view of the construction of the Houghton County Street Railway Company's line, it being the experience of every growing town and district that the trolley line leads to great expansion in every direction that growth is permitted.

The Old Colony is older and farther advanced in development work than the Mayflower. Its shafts are deeper, and it also owns considerable lands west of the western boundary of the Mayflower.

Perhaps the most interesting piece of exploratory work at present in progress in the entire copper district is found in the Old Colony tunnel, which is being driven entirely across the tract. A tunnel is vastly more expensive than trenching, diamond drill work or test-pitting, but it is also much more satisfactory and conclusive. Trenches are highly useful, as are pits, but they are apt to find the various strata in a considerably disorganized condition near surface, from the action of the elements for untold ages. Diamond drill boring is cheap and to a certain extent effective, but at best it is merely a preliminary examination. If something of promise is found by the drill, the ground must actually be opened by shafts or adits to verify the promise, while frequently the drill does not tell enough about the formation, or

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misses the goal entirely. With a tunnel, especially where driven across the formation as in this case, the last word is said regarding exploration. The miner can actually see for himself what the ground is like, and anything of promise can readily be followed, while occasionally an isolated bunch of good rock, which might give rise to extravagant anticipations if cut by a drill, is met with the tunnel, and speedily set down at its true value, by reason of the opportunity to determine its real extent and the lack of value in the lode at a few feet or few inches distance.

The Old Colony tunnel was started in the summer of 1899, at the lowest point of land available for the purpose, in order to give drainage and get deep enough below the ledge of rock to cut the formation where unaltered by climatic influences. The adit begins at the Eastern Sandstone, which underlies the trap strata carrying the copper-bearing conglomerates and amygdaloids, and runs about 33 degrees north of west, this angle being chosen to give a cross-section of the formation and permit the penetration of the greatest number of strata in the least horizontal distance. The tunnel is now in approximately 1,250 feet west of the Eastern Sandstone, and will run for about 4,500 feet before reaching the Old Colony boundary line. The results from the first thousand feet of the adit are of much interest geologically and have assisted in clearing up a number of uncertain points regarding the stratigraphy of the mineral belt, in addition to which the tunnel has given important results from a strictly mining standpoint. The first stratum of promise was a conglomerate overlying a wide belt of amygdaloid, and on this conglomerate a shaft is being sunk. The results have hardly come up to the anticipations formed from the rich rock shown in the lode where cut by the tunnel, but the shaft is not without promise. The richest portion of the conglomerate seems to be in a few feet of the portion overlying the footwall of amygdaloid, and in the portion of the latter next to the hanging of conglomerate, the greater values being in the conglomerate. It is quite certain that both amygdaloid and conglomerate are to the east of the Isle Royale lode, which, with the exceptions of the Baltic further south, and the "Mabbs Vein," which may be either a fissure vein or a true stratified bed, is the most easterly lode on which actual mining has been done in any portion of the copper district. The conglomerate on which the Old Colony shaft is being sunk is less than 200 feet from the Eastern Sandstone, and the underlying amygdaloid is unquestionably the most easterly cupriferous stratum of the Keweenawan series, as exposed. The conglomerate runs 15 to 20 feet in width, with the amygdaloid beneath having a little greater width. To the westward of this conglomerate several lodes carrying copper to greater or less extent have been located. One of these, a conglomerate cut in August, 1900, shows considerable copper, and one small mass of seventeen pounds weight was found in the lode, in the middle of the tunnel. A little drifting was done on this latter conglomerate, and it will probably receive more attention

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later; but for the present more effort is being made to push the tunnel along than to open on the numerous copper-bearing bodies cut thereby. Of course if anything of a superlatively rich nature were found, such as a duplicate of the Calumet conglomerate at its richest, it would be developed at once, but the management is not building plans on striking another Calumet. Its work is based on the law of averages, and no matter what the outcome may be, the Old Colony, when its tunnel is completed, will have become the most thoroughly explored copper property in the entire Lake Superior district, not excepting the Calumet & Hecla or any other mine. When the tunnel is completed the Old Colony will have from ten to thirty lodes, all carrying copper to some extent, ready for whatever future work may be decided upon. It will then be a simple matter to concentrate efforts and expenditures upon one or two of the most promising. The plan is an eminently sound one, and in view of the great extent of mineral territory I am of the opinion that the Old Colony people have more than an even chance of finding a good mine somewhere along the line of their tunnel. It is possible that several paying lodes may be so located. Even should this not prove the case, the shareholders will have the satisfaction of knowing that their property was explored as no other copper mine has ever been probed, and as not half a dozen large mineral properties in all the world have been searched.

In addition to the tunnel and the shaft previously mentioned as sinking on the eastermost conglomerate of the copper belt, there are two other shafts, one of which is called the "Pump Shaft," and is in a wide amygdaloid showing copper, with a little silver at times. The "West Shaft" is on the same lode as the west shaft of the Mayflower, supposed to be the Isle Royale, the amygdaloid showing the same characteristics as to the northward, carrying large quantities of epidote and considerable prehnite, calcite and quartz, being of a brownish color and bearing close resemblance to the Isle Royale lode as opened in the mine of that name, twelve miles to the southwestward. The lode seems bunchy, but has shown some excellent rock at various points where opened.

The Old Colony is following a very wise policy in expending its money below surface rather than above. The surface expenditures have been limited to the actual necessaries, but such buildings as have been erected are substantial and the machinery installed is new and well suited for the work in hand. There are two engine houses, two compressor houses, three boiler houses, carpenter, blacksmith and machine shops, warehouse and office, "drys" for the miners, and about a dozen comfortable frame dwellings.

The company began business very late in 1898 with a cash working capital of $250,000, in addition to the real estate. The principal financial items in connection with the company's affairs are shown as follows, from the sworn statement rendered to the State of Michigan under date of Dec. 31, 1899;

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Amount of cash paid in on capital stock..	$1,000,000.00
Amount paid in by conveyance of property	.....
Amount invested in real estate.	750,000.00
Amount of personal estate.....	161,910.69
Amount of floating debt.....	.....
Amount due the company.....	.....

The expenditures of the company for the first year of operations were as follows, the figures being taken from the first annual report to shareholders:

For real estate (the lands of the company)	$750,000.00
Buildings, machinery, dam, roads, etc.....	24,238.16
Labor and materials	32,621.09
All other expenses.....	12,890.36

Giving an actual expenditure of $69,749.61 in carrying on the company's business for the first twelve months of its existence.

ONECO.

The Oneco Copper Mining Company was organized under the laws of Michigan with a capitalization of 100,000 shares, in 1899. W. F. Fitzgerald is president, and S. S. Millett secretary and treasurer. The general offices are in Boston. The number of shareholders on Dec. 31, 1899, was 172.

This property was formerly known as the Hungarian, the name being changed a few years ago to Fitzgerald, under which title no work was done on the mineral tract. The Hungarian was one of the oldest mining locations on the outskirts of the Portage Lake district, but no great amount of work was ever done there. The Oneco, as at present constituted, consists of 800 acres of land, all on the mineral belt, lying in Sections 2, 3 and 10, Town 55 North, Range 33 West. It has the Dover and Torch Lake mineral properties and lands of St. Mary's Canal Mineral Land Company to the north; Canal lands and a tract owned by the Tamarack company on the east; Tamarack and Canal lands on the south, and the Arcadian, Union Land & Copper and Canal lands on the west. The tract is very irregular in outline, there being 160 acres in the northeast corner which join diagonally on the main tract of 640 acres. The greatest length on the strike of the formation is 1⅞ miles. The 160 acres in the northeast lie half a mile west of the Eastern Sandstone and the main tract has its eastern boundary three-quarters of a mile west of the sandstone.

An exploring shaft was sunk on the Hungarian lands to a depth of less than 100 feet in 1862, and the showing then made created some excitement locally, but for some reason work was stopped. A little exploring was done on the property in 1890 by Capt. W. A. Dunn, and some additional work was performed in 1898 under the direction of Mr. Fitzgerald, before the formation of the Oneco company. A rich

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outcrop of conglomerate was found, but this proved to be a drift boulder of large size, and not rock in place.

The first actual mining work was done by the Oneco company on June 26, 1899, when the first sod was turned for the permanent shaft. The work was begun under direction of Capt. Joseph Hocking, who remains in charge of the property, as superintendent and mining captain. The shaft is of two compartments, well timbered through the overburden. The shaft is down more than 500 feet, at this writing Nov. 8, 1900, and a little drifting has been done on four levels, probably about 500 feet in all. The lode is of fair width and carries copper in sufficient amount to give promise of opening a profitable mine, if worked on a large scale. One of the interesting things met with in the descent of the shaft was a narrow fissure carrying a large amount of barrel copper. A little drifting was done on this fissure, and it will be given further attention in the future, but the present policy of the company is to concentrate energies on sinking, with a little drifting at each level as opened. The fissure is of geological interest also, being one of the few productive cross-veins found in the Portage Lake district.

The lode on which the shaft is sinking has generally been considered the Isle Royale or Grand Portage, but Capt. Hocking believes it to be the Kearsarge amygdaloid. The shaft is apparently in line with the northern strike of the twin lodes named, and is certainly much east of the Kearsarge lode produced, but it is possible that though faulting or twisting the Kearsarge has been thrown to the eastward on the Oneco property; but in the light of present evidence it seems scarcely probable that the Oneco shaft is located on the Kearsarge lode.

The affairs of the company are being managed with exceeding prudence by Capt. Hocking, who is probably getting as many feet of opening for the money spent as is being secured at any new mine in the district. At present only twelve miners are employed, but these are picked men and are sinking the shaft quite rapidly. The surface force is even smaller, so that less than twenty men all told are now on the Oneco payroll. The surface improvements consist of one building for engine, boilers and compressor; blacksmith shop; warehouse; mine office; powder house; office; shafthouse, and eight dwellings on Dover Creek. The compressor is capable of furnishing air for six drills, twice the number in use, and the hoist is good for the depth of a quarter-mile.

The lode is very flat—much flatter than any lode so far opened either to the northward or southward in Houghton county, running only about 33 degrees, or flatter than any mine opened west and south of the Arnold ashbed. The shaft was started at an angle of 45 degrees with the horizon, which is about the angle that would have been expected for the dip of the lodes one mile west of the underlying sandstone in the Oneco neighborhood, but it becoming apparent at little depth that the shaft was losing the lode and making into the

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footwall, the inclination was changed to 33 degrees. It is possible that the permanent angle may prove a trifle sharper than 33, owing to the rolling of the lode in its dip.

In addition to the amygdaloid now being opened, other cuperiferous beds are supposed to cross the Oneco lands. Two additional copper-bearing amygdaloids have been located, one to the east and one to the west of the lode now being opened.

At the annual meeting of the company, held in March, 1900, the treasurer's report for the year ending Dec. 31, 1899, showed receipts of $210,000 from the sale of 70,000 shares of the capital stock of the company, also $318 received as interest. The price paid for the lands was $150,000, leaving $60,318 available for exploratory and development purposes, of which amount $34,843 was expended in 1899, leaving an available balance of $25,475 in cash and supplies at the mine.

The following items relating to the affairs of the Oneco company are from the sworn statement returned to the State of Michigan, under date Dec. 31, 1899:

Amount of cash paid in on capital stock	$ 60,000.00
Amount paid in by conveyance of property	150,000.00
Amount invested in real estate	157,079.61
Amount of personal estate	36,477.72
Amount of floating debt	1,972.22
Amount due the company	.....

RHODE ISLAND.

The Rhode Island Copper Company is the successor of the old Rhode Island Mining Company, which did a small amount of exploratory work nearly forty years ago. The present company was organized late in 1899, under the Michigan laws, with a capitalization of $2,500,000, having 100,000 shares of the par value of $25 each, and its entire capital stock is issued. Shares were subscribed at $5 each, giving a cash capital of $500,000, of which $300,000 was paid for the real estate and a cash fund of $200,000 placed in the treasury for development and equipment. There were 1,100 shareholders of record on December 31, 1899. T. Henry Mason is president and W. R. Todd secretary and treasurer, with principal offices at 45 Broadway, New York City. Capt. Thos. Dennis, for many years mining captain at the Franklin, is agent of the Rhode Island, succeeding Capt. Samuel B. Harris, of the Quincy, whose attention was too fully occupied with the multifarious duties connected with that great property to allow his giving the time required in the supervision of the Rhode Island.

The Rhode Island realty consists of 800 acres on the mineral belt, being all of Section 5 and the southwest quarter of Section 4, in Town 55 North, Range 33 West, giving a compact territory one mile in width, from north to south, and one and a half miles long for the southern half of the tract, thus providing a good extent of territory

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as to both strike and dip, for any mineral bodies developed. The Franklin Junior lies to the south, the Rhode Island being surrounded on the other three sides by undeveloped mineral lands.

The first mining work was done in November, 1898, and consisted of trenching across the Pewabic lode, which lies about 475 feet west of the Allouez conglomerate on the Rhode Island property. What becomes of the wide belt of greenstone overlying the Allouez conglomerate further north and east is a mystery. It is possible that the two lodes have not been correctly identified, though the preponderence of evidence is in favor of the nomenclature given.

When trenched across on surface, the Pewabic amygdaloid ran eight to ten feet in width, and carried more or less barrel copper and stamp rock. The lode is by no means as wide or as rich, so far as determined, on the Rhode Island and Franklin Junior as a few miles to the southward in the Franklin and Quincy mines. The first shaft, No. 1, was started at a distance of only 275 feet north of the Franklin Junior boundary line. No. 2 shaft is located 1,200 feet northward of No. 1, on the same lode, which was found by means of a crosscut run from a 60-foot sand-shaft sunk through the overburden. At the present writing, Nov. 8, 1900, No. 1 shaft is below the third level and No. 2 below the second level. There is an overburden of about 65 feet at each shaft, measured on the angle of sinking. The shafts are 8 x 18 feet in size inside of timbers, with three compartments, two of which will be used for hoisting and the third for pipes and ladders. The shafts are very substantially timbered, and of sufficient size to ensure their ability to handle the product from a large mine. To the northward there is undeveloped territory with room for two additional shafts on the same lode, on the Rhode Island lands, the property having the outcrop of that lode for a length of about 4,600 feet, or approximately seven-eighths of a mile, giving more than 3,000 feet on the outcrop north of No. 2 shaft. The ground opened by both shafts and the drifts therefrom shows the lode of an average width of eight to nine feet, and quite bunchy in character. The copper, as a rule, is found near the hanging wall, where two to three feet is richly mineralized at many points. A considerable amount of barren ground has been gone through, but the history of the lode, where opened to the southward, is that the richer ground is found at considerable depths. This may not prove true at the Rhode Island, but is likely to be the case. The present developments do not indicate a rich mine, so far as opened but do give promise of a workable mine, with strong hopes of better ground at greater depth.

The work of the old Rhode Island company, in the early sixties, was confined to the Allouez conglomerate, on which three shafts were sunk to the depth of 170 feet each, and connected underground. It is said that considerable copper was secured therefrom by the Rhode Island company, but no record of such production has been found. A mill test of rock from this lode, taken from the Franklin Junior mine, just to the southward, gave returns of better than 1¼ per cent copper

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last spring; whereupon the Franklin management began reopening the old conglomerate workings. As a result of this test the Rhode Island also unwatered the old shafts on the Allouez lode, and has done some drifting therein during the past three months. The results of this work are of a somewhat negative nature, the rock giving indications of value, but hardly meeting expectations raised by the mill-test of the Franklin.

In addition to these two lodes on which opening work has been done, there are the Mesnard epidote, the Hancock and Osceola amygdaloids, and the Atlantic ashbed traversing the Rhode Island lands, and probably other unidentified strata carrying copper to greater or less extent. The Rhode Island offers a fine prospect for a crosscut traversing and proving the formation from east to west. A crosscut of this sort was sent eastward from the Franklin Junior several years ago, but the strata west of the Pewabic are but little known.

The surface improvements at the Rhode Island are of a substantial nature, evidencing considerable faith in the property on the part of the management. There is a combination machine and carpenter shop, of frame construction, 30 x 60 feet in size; a warehouse and supply office 30 x 50 feet, with mine office in the front portion; also blacksmith shop, powder house, etc. The main engine house contains a ten-drill Rand compressor, and at each shaft there are Nordberg hoists, duplicates, capable of hoisting 2½ ton skips from a depth of 1000 feet. The boilers and machinery are all new and of the best make. Underground there are pumps capable of handling the expected inflow of water until the mine gets to nearly three times its present depth. The shafthouses are of frame and well built, with room for rock-house additions whenever desired. There are fifteen dwellings on the location, including a $3,000 house just completed for the agent. Like the other new mines of the district not located in immediate proximity to the cities, some difficulty has been experienced in getting the right kind of labor in sufficient quantity, as the best men require good accommodations, and the married men, who are always steadiest, demand homes. With the big boarding house and dwellings now completed, the Rhode Island is caring very comfortably for the present force of about 50 men.

The financial statement issued to shareholders on January 18, 1900. covers the cash accounts of the company for the first fifteen months of its existence. The items of the statement are as follows:

Received from sale of capital stock	$500,000.00
Received from interest	2,468.15
Total	502,468.15
Paid for real estate (the Rhode Island lands)	300,000.00
Expenditures for machinery, supplies, labor etc.	49,732.38
Total	349,732.38
Cash balance on hand	152,735.77

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The following items are from the sworn statement returned to the state of Michigan, under date Dec. 31, 1899:

Cash paid in on capital stock	$500,000.00
Amount paid in by conveyance of property	.....
Amount invested in real estate	300,000.00
Amount of personal estate	152,735,77
Amount of floating debt	.....
Amount due the company	.....

ARCADIAN.

The Arcadian Copper Company, of New Jersey, is incorporated under the laws of the state named, with a capitalization of $3,750,000, divided into 150,000 shares, of the par value of $25 each. It is the successor of the Arcadian Copper Company, incorporated under the laws of Michigan in June, 1898. The reincorporation under the laws of New Jersey was made in 1899, to secure additional capitalization, the limit allowed by the Michigan laws having been taken at the time of the first incorporation.

The principal office of the company is Boston, with A. C. Burrage, president; C. D. Burrage, secretary and treasurer; Nathan F. Leopold, of Chicago, general manager. The local officials are, Robert H. Shields, superintendent, succeeding Dr. Edgar Kidwell, who resigned in January, 1900; James Wilcox, mining captain, and Henry C. Krause, mill superintendent.

The mineral lands of the Arcadian comprise six old mines, or mining tracts, these being the Arcadian, Edwards, Douglass, Concord, Highland and St. Mary's. The first four properties named were included in the original tract on which the first Arcadian Copper Company organized, in 1898, and the two latter have been acquired since that time. The lands comprise about 4,000 acres, all on the mineral belt, the extreme southeastern corner just touching the underlying sandstone as approximately located by the State Geological Survey. The lands consist of the north half and the southwest quarter of Section 13, Town 55 North, Range 34 West, and all of Sections 17, 18, 19 and 30, with portions of Sections 9, 16, 20, 29 and 31 in Town 55 North, Range 33 West. A portion of the surface rights of lands in 25-55-34 and in fractional Section 31, 55-33, are held by other owners. There is a water frontage of one mile, on the northern shore of Portage Lake, on the last named tracts, a portion of which is owned by the Arcadian. The lands are the most extensive held by any mining corporation on the mineral belt, in the active district of the Keweenaw peninsula, though there are larger holdings on Keweenaw Point, where no mining is now being done. The extreme length of the Arcadian tract is four miles, north and south and the greatest width four miles east and west. The extreme length, measuring East of

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North, which is also the trend of the formation, is exactly five miles. The neighbors of the Arcadian are the Franklin Junior and sundry undeveloped mineral lands on the north; the Oneco and undeveloped lands on the east; undeveloped mineral lands and Portage Lake on the south; and the Quincy and undeveloped mineral lands on the west. The boundary line of the Arcadian is 17½ miles in length.

The six properties comprised in the present Arcadian consolidation have produced at various times about 650 tons of refined copper, according to the records, before their amalgamation in the present corporation. The preliminary work on the company's account was done in the fall of 1897, and the corporation was organized in June, 1898, Standard Oil magnates taking a heavy interest in the flotation. Immediately after organizing, work was begun on a scale never before seen at any new mine in this field, and never witnessed at any but three or four of the very largest mines of the district. Great shafts were started into the bowels of the earth at a half dozen points, and as rapidly as depth was gained drifts were run both north and south on every level, and as much as 1,800 feet of opening work was performed in a single month—a record that has never been duplicated by any mine but the Calumet & Hecla. Steel shafthouses were erected, great engine houses of stone sprung up, and where cows had pastured around a half dozen decaying dwellings one year before, a town sprang up, as if by magic, with two parallel streets each a mile in length. At the millsite selected on Grosse Pointe, Portage Lake, one mile east of the new Franklin mill, there was equal activity, though upon a smaller scale, and a magnificent stampmill, equipped with the best and costliest machinery was built in a marvelously short time. At the height of activity no less than 1,100 men were carried on the payrolls of the Arcadian, in addition to about 500 more employed by the various contractors and sub-contractors who were building the mill, dwellings and mine structures of different sorts. As a result, the Arcadian has an equipment which is exceeded by that of only a few mines on the globe—the number could be counted on the fingers perhaps.

All this work cost a vast amount of money—just how much is known to the management only. Two million dollars would probably be a very conservative estimate. I am unable to give any statistics regarding the financial condition of the corporation.

It is to be regretted that the expenditure of such a vast amount of money and the elaborate preparations made for production upon a large scale have not been rewarded by the opening of a better mine. The rock has proven very disappointing, giving considerably less than one per cent ingot in the mill. The original plan was to duplicate the first mill of three stamps with a second mill during the season of 1900, but this plan was abandoned when it became evident that the mine could not supply the three stamps already installed with the selected rock required to run them to their full capacity, which is a little

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more than 500 tons each, daily. The lode runs 10 to 12 feet in width and is not rich in copper, as a whole, though showing occasional bunches of fine ground. It is generally thought that the Arcadian is opened on the northerly continuation of the Isle Royale amygdaloid, but I am of the opinion that the Arcadian is located on the Grand Portage, and not upon the Isle Royale lode. These two amygdaloid beds are twins, lying parallel at a distance of less than 200 feet apart and presenting similar characteristics, both carrying epidote in large quantities, the green color of this mineral being a marked characteristic. Prehnite, calcite and quartz are also carried freely. Where opened on the various properties contained in the present Isle Royale mine, at Houghton, three miles south of the principal shafts of the Arcadian, the Isle Royale lode was usually the better of the two, though the average width and copper content of the Portage were greater than at the Arcadian.

In addition to the epidote amygdaloid on which the mine is opened, there are numerous other copper-bearing strata on the large tract owned by the Arcadian. One of these is the Mesnard epidote, from which one enormous mass of native copper was secured some thirty-five years ago, being found about 50 feet from the matrice from which it had been removed by prehistoric miners. Attention is now being given this lode by the Arcadian management, with quite promising developments. The first work was done late last spring, when an old shaft on the St. Mary's property was unwatered, partially with a view to crosscutting to determine the formation at that point. The epidote showed well in copper and it was found that there were three shafts sunk thereon, one of which was down nearly 200 feet. The lode runs about nine feet wide and is well charged with barrel and stamp copper. A careful mill test of 1,000 tons of rock was made, after which the president and general manager of the company made a personal inspection of the lode and a second mill test was made. That this was confirmatory of the first, was shown by the company immediately starting two permanent shafts on the Mesnard lode, No. 1 being to the north and No. 2 lying 1,800 feet southward. Both are permanent three-compartment shafts, 8 x 18 feet inside of timbers, and are being pushed down rapidly. A 4-inch pipe line has been run from No. 4 engine house and furnishes the compressed air, supplying motive power for hoists and drills. The shafts are now each in the neighborhood of 250 feet in depth. The value of this lode can be fully determined only by extensive development work and the final test of actual milling, but the rock obviously carries copper in considerable quantities and the outlook is promising.

On the amygdaloid originally opened by the Arcadian, the southern end is apparently the richer. The openings from this lode are furnishing rock for two stamps. The production of mineral by the mine is not given out, but is probably under 100 tons per month. The mineral averages high in ingot copper, ranking well up toward Wolverine and Osceola mineral in this respect.

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There are seven shafts opened on the amygdaloid. The southernmost shaft is called "B," and is now idle, but will be worked again when the next shaft to the north is better developed. "A" shaft lies 1,500 feet north of "B;" No. 1 is 1,600 feet north of "A;" No. 2 is 1,600 feet north of No. 1; No. 3 is next, at a distance of 1,700 feet; No. 4 is 1,150 feet further north, and No. 5, the northernmost is 1,800 feet beyond No. 4. This gives a distance of 9,350 feet opened on this one lode. This is the greatest length of lode opened by any mine in the district, with the exception of the new amygdaloid shafts of the Calumet & Hecla, which have opened almost precisely the same length of territory on the Osceola lode. These shafts are all sunk at an angle of 56½ degrees, which seems the average dip of the lode on the Arcadian lands.

The principal shafts, Nos. 1, 2, 3 and 4, are fitted with duplicate plants, and hoist with six-ton skips. The hoists are duplex Nordbergs, with cylinders 32 x 72 and 48-inch stroke, carrying 1⅛ inch steel cable, and with drums and power calculated to hoist six-ton loads from a maximum depth of 6,000 feet. The engine houses are of stone and steel, and boiler houses of the same materials, fitted with the very best boilers, largely Stirling water-tube type, carrying 200 pounds steam pressure to the square inch. The shafthouses are uniform, 44 x 64 feet on the ground and 86 feet high to the headsheave. The rockhouses at each are fitted with duplicate sets of jaw crushers, with openings 17 x 24 and 13 x 20, also steam hammers for handling masses, the machinery in each rockhouse being driven by 10 x 24 Corliss engines.

The heaviest machinery is at No. 4 shaft, where there is a stone engine house 67 x 156 feet in size—one of the largest and finest in the district. The big 70-drill compressor is located at this point. It was installed in the spring of 1900 and is a triple-expansion three-stage machine, with tubular air coolers between the air cylinders, and has proven highly efficient and enconomical in its work. At No. 3 there is a 35-drill compressor, and a compound two-stage compressor of slightly smaller capacity at No. 2 engine house; also an 18-drill compressor at No. 1, and a small 3-drill compressor used for exploratory work.

In the way of shops the Arcadian has probably the best planned equipment in the district. At other mines one shop has followed another and additions have been constructed as required, while the Arcadian shops appeared upon the scene full grown. There are four buildings, each with main structures 30 x 60 feet in size, with wings, all in a row, and connected, built of steel, on stone foundations and fitted with a single main-line of shafting, from which the various machines take power, as required, by means of friction-clutch attachments. These permit the use of power as required, without running a great deal of heavy machinery to no purpose in order to obtain motive force for one or two machines. These four buildings are the smithy, machine shop, carpenter shop and warehouse. The machine shop is magnificently fitted with tools, there being a 10-foot planer, lathes of

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10, 12 and 20-foot lengths, a 5-foot radial drill and minor machinery in keeping. The carpenter and blacksmith shops are furnished on a similar scale, and the company makes all its skips and minor tools and fittings for every-day use. The machinery in the shops is driven by a 10 x 30 Corliss engine.

In the way of "drys," tool-houses, oil houses, etc., there is a full equipment, also a mine office with good vaults and ample accommodations for the superintendent, captain and clerical force; fine residences for the local officials; a store, built for the convenience of employees, but which is not a company store, being run by an independent firm; a $6,000 schoolhouse, built on modern lines, for the benefit of the rising generation, and about 150 dwelling houses, nearly all of which are new and of six rooms each. The better among the old dwellings on the various locations have been remodeled, and the others torn down.

The water supply is obtained from the old Boston dam, which once furnished water for the mill of the Albany & Boston mine. It is brought to the mine for a distance of two miles through a 9-inch main, by gravity. There is a 110,000-gallon reservoir at No. 3 shaft, from which the water is distributed through 6-inch mains to the various buildings on the mine location. At this point there is a large fire-pump in a substantial stone building, which can give a heavy pressure on short notice, in case of fire. All the principal buildings being of stone and steel, the risk is reduced to the minimum, and with the ample supply of water and hose at every point, serious damage from fire to any of the surface improvements of the mine seems out of the question.

The Mineral Range railroad runs to the mine, reaching all of the principal shafts and mine buildings. The shafthouses are built with large bins, and the rock-cars, of the largest size, run underneath. A branch line was built by this road in 1899, connecting the Arcadian and Franklin Junior mines with their mills, which are on Grosse Pointe, Portage Lake, the Arcadian mill being distant from the mine about six miles by rail, with a down-grade haul for the entire distance.

The stampmill site consists of 406 acres, and has a water frontage of 1¼ miles, giving ample sand-room for generations to come. The site is one of the finest occupied by any mill in the district, and the mill itself, while exceeded in size by several others, is second to none in construction, equipment and efficiency. The mill building is of steel, on masonry foundations, the stone for which was quarried on the company's lands, a scant quarter mile away. The building is 132 x 213 feet in size, and is supplied with steel rock-bins which are made a portion of the main structure, and a steel railroad trestle leading from the bluff behind the mill to the bins. There are three stamps, each capable of sustained runs of 550 tons daily; 108 jigs and nine double-decked Fraser & Chalmers slime-tables, each equal to two tables of the ordinary pattern, though occupying the same room. The

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boiler house, adjoining the mill, is also of steel, and houses five high-power boilers. A self-supporting steel smokestack, lined with brick, provides draught. There is a pump-house, also of steel, in which is located a 15,000,000 gallon triple expansion pump, which is capable of furnishing water for a mill of double the capacity of the present one. A substantial wharf, on piles, runs 675 feet into the lake, giving deep water and ample room for the discharge of coal and merchandise cargoes. There is a coal shed and all other appointments usually found at a modern stamp-mill in the Lake copper district. The results secured recently at the mill are highly creditable, milling costs having been cut to less than 25 cents per ton, or to the rock-bottom basis reached by the Tamarack and a few other of the best mills of the county. There are dwellings at the mill for employees, and a considerable population is clustered there.

For a three-year-old the Arcadian has made a great deal of history. It has trotted a rapid pace, and the goal is as yet uncertain. The brief career of the mine may be divided into two periods; the first, preceding the opening of the mill, composed of lavish promises and unreasonable expectations; the second, after the starting of the mill, is made up of blasted hopes, unsparing and unreasoning criticism, and a reversal of public sentiment as unreasonable in its way as were the former anticipations of opening a second Calumet & Hecla on the made-to-order plan. The truth lies between these extremes. The troubles of the Arcadian were two in number—too much money and too little copper. The first has been effectually overcome, and it is by no means impossible that the second may also be vanquished. The eastern management of the Arcadian overestimated the possibilities of the lode on which the mine was opened and underestimated the requirements attendant upon opening a paying mine. Things were done which would not be done were the opportunity afforded of again developing the mine; but the management is not crying over spilled milk. An investment of millions has been made where the investment of hundreds of thousands would have been much wiser; but the money is there, and only two courses are open for pursuit: The first is to quit and give the mine up as a bad job. The second and wiser course has been taken; this being to curtail expenses, lop off all unnecessary drains upon the exchequer, mine and mill as much rock as can advantageously be taken from the property, close the unproductive shafts on the amygdaloid and continue the search for other cupriferous lodes. The mill is not earning the anticipated dividends, but it is probably coming very near to paying the actual running expenses of the property, outside of the development work on the epidote and the exploratory work with a diamond drill which has been in progress during the summer and fall of 1900. Great economies have been effected in the administration of the Arcadian company's affairs during 1900. Superintendent Shields has proven himself a careful manager, and without skimping necessary expenditures has cut the running costs nearly in two, while increasing the production of refined copper.

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At present the chief hope of the mine lies in the epidote now being opened, though the older workings are gradually increasing their output of selected rock. The Mesnard lode is making a good showing, and if the present promise is maintained will help the Arcadian to get back some of the money spent on the property. The Arcadian cannot yet be called a success, but it is premature to term it a failure.

FRANKLIN.

The Franklin Mining Company is one of the oldest corporations in the Portage Lake district, and has been continuously operated for more than forty years, in which time it has levied assessments of $220,000 and has paid dividends of $1,240,000. The officers of the company are F. H. Raymond, president, succeeding the late T. H. Perkins; Daniel L. Demmon, secretary and treasurer; with the main office at 19 Congress street, Boston. The local officials are Joshua D. Hosking agent, succeeding Graham Pope in 1899; Arno Jaehnig, clerk; Thomas Kelly, mining captain at the old Franklin; Nicholas Clymo, mining captain at the Franklin Junior: A. Butler, master mechanic; John Daniell, mining engineer, and Edward Warne, mill superintendent.

The company has an authorized capital of 100,000 shares, of which 80,000 shares are issued and 20,000 remain in the treasury, the increase from 80,000 shares having been made in May, 1899. The real estate of the company consists of 160 acres on which the old Franklin is located; 1,359 acres of surface at the Franklin Junior, which carries mineral rights to 1,520 acres, and a millsite of something less than 200 acres, at Grosse Pointe, Portage Lake, facing on the portion of the lake known as the Grand Portage, and carrying a frontage of about one mile. The old mine consists of the southwest quarter of Section 2, Town 55 North, Range 33 West, with Canal lands, undeveloped, on the east, and the Quincy mine on the other three sides. The Junior mine has the Rhode Island and undeveloped lands to the north, the Arcadian and undeveloped mineral lands to the east, south and west.

The Junior mine was opened originally as the Albany & Boston in 1860. In 1882 the property was transferred to the Peninsula company, and in 1895 the tract was bought by the Franklin, which immediately began work at that point, opening a mine on the Pewabic amygdaloid, on which a single exploring shaft about 90 feet deep had been sunk a generation before.

The Franklin stopped production from November, 1898, when the old mill was burned, until August, 1899, when the new mill was started.

At the Franklin Junior there are two separate mines, one of which is the old Albany & Boston, on the Allouez conglomerate, the other being the mine opened on the Pewabic amygdaloid by the Franklin company, the latter lying 475 feet west of and parallel with the first-named mine. The shafts on the amygdaloid are numbered from north to south, the first to the northward being the North or "Klondike" shaft, about 900 feet south of the Rhode Island mine, and the

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last shaft opened on the Pewabic lode, having been started in 1899. It is now approximately 1,000 feet in depth. No. 1 shaft is 1,100 feet to the southward, and is the deepest at the mine, being down about 1,600 feet. No. 2 is 1,500 feet still further south, and is about 1,200 feet deep. No. 3, the southernmost, is 1,100 feet south of No. 2, and is about 400 feet in depth. No. 2 shaft has been abandoned, for the present at least. It carried some barrel copper and occasional masses, but was almost totally devoid of stamp rock. The "North" shaft is the richest opened on that lode, but a large part of the product of the mine comes from No. 1. The four shafts on the Pewabic are sunk at the angle of 48½ degrees. The lode varies in width from 3 to 15 feet, an average of 9 feet probably being a fair figure. No. 1, the deepest shaft of the mine, has 16 levels opened, and is wider and richer on the bottom level, 1,600 feet below surface, than at any point above. As the Quincy, Pewabic and Franklin mines passed through poor ground between the 10th and 13th levels, and found their real riches below the quarter-mile depth, the widening and richening of the lode at the bottom of No. 1 in the Junior is regarded as a highly favorable sign.

Pewabic shafts Nos. 1, 2 and 3 were equipped with good combination shaft and rock-houses 40 x 50 feet on the ground and 96 feet high. On the abandonment of No. 2 shaft it was decided to move the nearly completed shafthouse at that point to No. 1 shaft of the conglomerate workings, and the work was performed by Mr. N. S. Bray, of Laurium, in ten weeks. The building was of the large size stated; contained upwards of 200,000 feet of lumber and weighed nearly 250 tons. It was moved across a shaft, over a rock burrow, through a swamp, and finally set up in good shape at No. 1 conglomerate shaft, 1,800 feet distant, where it was speedily enclosed and fitted with crushers. The job of moving was much the greatest ever undertaken in the district, and was highly successful in every respect.

A crosscut was sent from the Pewabic to the Allouez conglomerate workings in the spring of 1900. Rock taken from the conglomerate returned between 1½ and 2 per cent mineral at the stampmill. The rock from this lode averaged better than 1 per cent mineral when worked by the Peninsula company, previously to 1892. As a result of the mill test, the Franklin management decided to reopen the old conglomerate mine. The plan of opening by crosscuts and hoisting through the amygdaloid shafts was canvassed, and abandoned in favor of reopening the old conglomerate shafts. The shafthouse was moved from No. 2 amygdaloid to No. 1 conglomerate, the old Albany & Boston and Peninsula shaft No. 1, and the mine unwatered. No. 1 conglomerate shaft is 1,400 feet deep, but has little drifting and comparatively no stoping done below the ninth level. The old shaft had but a single skipway, and is being cut down to three-compartment size, from surface. There will be two skip-tracks and a ladder way carrying pipes also, giving the enlarged shaft an inside measurement of 6½ by 18½ feet. The water is forked from this shaft by a Cornish pump. The shaft is

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now cut down and retimbered to nearly the fourth level, and the entire job will be finished in the spring or summer of 1901. Drifting is being done on several levels and the ground opened shows copper at nearly all points. Judging not only from the appearance underground, but from the actual results of continued mill-practice, the Allouez conglomerate, on the Junior lands, is much wider, more regular and considerably richer than the Pewabic amygdaloid, considering the average of ground opened. The hope of making a mine out of the Junior on the amygdaloid rests on better developments in the bottom levels than have been secured near surface. The conglomerate runs as wide as 32 feet at points in the old mine, and is underlaid by a six foot bed of conglomerate sandstone, under which there is an amygdaloid-trap, barren of copper. The lode is quite bunchy, and there are considerable barren stretches, but at some points the rock is much richer than the average of the best mines of the district, having given mill returns of 4 per cent ingot from selected rock and as high as 13 per cent ingot in smelter tests. Of course nothing like these percentages can be obtained by the modern methods of mining, where the practice is to stamp everything that can be made to pay the costs of breaking, hoisting, transporting, milling and smelting. If the lode can be made to return 1 per cent mineral, and any large proportion of it can be mined, it should pay. The Albany & Boston could not make it pay, and the Peninsula failed to earn a profit on one per cent rock; but the Franklin has a strictly modern mill and the means and disposition to open the mine on a large scale. From present appearances the best hope of the Junior lies in opening a very large mine on the conglomerate, and milling all but the leanest portions of the lode. There is still a fair prospect that the amygdaloid workings may improve with depth, but up to this time they have proved disappointing.

In addition to the two lodes mentioned, the Mesnard epidote was opened in August, 1900, by a crosscut and, at the point where cut, was rich in very fine copper. The exact value of this lode on the Junior lands can be determined only by opening to a considerable extent, which will take time. The encouraging results obtained in this lode by the Arcadian, lying next south, are naturally favorable to the Junior.

In addition to the Allouez conglomerate, Pewabic amygdaloid and Mesnard epidote, the Franklin Junior tract also carries the Calumet conglomerate and Osceola and Kearsarge amygdaloids. These have been found by a crosscut driven east for a distance of 2,633 feet—almost exactly one-half mile. The Calumet lode is a mere seam of conglomerate sandstone, in which enthusiasts have thought they were able to see copper, though the metal is otherwise undiscoverable. Neither of the amygdaloid beds were encouraging where found by the crosscut, but possibly might prove better at other points. It is not quite certain that the lode identified as the Kearsarge is really that bed, but the preponderance of evidence favors that conclusion.

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The Junior is well supplied with machinery. At No. 2 amygdaloid there is a Bullock hoist with 24 x 48 cylinders, having 12-foot drums with 8½-foot face, power for which is supplied by a battery of Stirling water-tube boilers of 500 horse power. There is a 35-drill compressor in a separate building. There are also two other compressors, of 10 and 12-drill capacity, and 30 power drills are employed in various parts of the Junior mine. At No. 1 conglomerate a new direct-hoist, good for a mile in depth, was installed in the summer of 1900, this having been bought of the Tamarack company. There are carpenter, blacksmith and machine shops at the Junior, well supplied with tools, and a considerable mine location, including a large number of good dwellings, many of them new.

The old Franklin is a "scram," but a valuable one. It was first announced fifteen years ago, that the old mine was on its last legs, and in 1890 it was thought that it could last only two or three years longer. Its shafts had all reached the boundary line and the good stoping ground was nearly exhausted. About this time the local management was changed, and Mr. Graham Pope, the new agent, began a systematic search through the old openings, for available stoping ground. This resulted in the discovery of a great deal of profitable ground previously overlooked, and upon the resignation of Mr. Pope and the installation of Capt. Hosking, the latter repeated the investigation of the former, and old workings, abandoned for years, are again being probed for overlooked copper. This process cannot go on indefinitely, and in time all the copper must be taken out, but between the copper left on the stulls and the available stopes, together with new milling ground opened by search through the upper and middle levels to the northward, in the ground condemned many years ago, there is stoping room for several years to come. It should be said in behalf of Messrs. Vivian and Pope, the former agents of the mine, that with copper at 17 cents per pound and a new mill to treat the rock, it is now possible to treat a great deal of low-grade rock that would simply have lost money for the company had it been touched before. It is also true that bunches of rich ground are apt to be met unexpectedly, so that taking everything into consideration, it will probably be some five years before the old mine is thoroughly exhausted. But it is a "scram," and its end, whether sooner or later, can be foretold.

At the old mine a new Bullock hoist has been installed at No. 5 shaft, from which the principal rock supply of the mine now comes. This was used for a few months previously, at the Junior. It has cylinders 26 x 48 inches, and can hoist two-ton loads economically from a depth of 3,600 feet. A new pump has been installed at Portage Lake, and supplies water to the mine and location, 700 feet above.

The new mill of the Franklin, on Grosse Pointe, started one head on Aug. 11 and a second on Aug. 22, 1899. There are three heads in place, with room for a fourth, the purchase and installation of the fourth stamp being under consideration by the management at this

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time. The stamps are averaging 450 tons of rock daily and have reached 500 tons on a test. Two heads are run regularly and the third head much of the time. The mill has about 90 jigs and 10 double-deck Fraser & Chalmers slime tables. Power is furnished by two 500 horse power Stirling water-tube boilers and a 16 x 22 Allis Corliss engine. The mill building is of steel, on sandstone foundations and is 177 x 194 feet in size. A self-supporting steel smokestack lined with brick, seven feet in diameter and 165 feet high, stands on a brick foundation 52 feet high, giving an elevation of 217 feet to the top of the stack. Water is furnished by an Allis pump of 15,000,000 gallons daily capacity, and there are electric lights throughout the buildings. There is a good wharf 267 feet long, with 18 feet of water alongside, coal sheds and about 20 dwellings at the millsite.

The product of the new mill has run as high as 235 tons mineral in a month, and is growing from month to month. For 1899, when the new mill was run 4½ months with two heads, the product was 1,548,864 pounds of mineral, equivalent to 1,230,000 pounds of ingot copper. This was secured from 89,789 tons of rock, of which 40,589 tons came from the old mine and 49,200 tons came from the Junior. This was stamped at a cost of 32.3 cents per ton, but the milling cost for 1900 will probably be about 30 cents, and perhaps a trifle less.

The production of 1,548,864 pounds of mineral, equivalent to 1,230,000 pounds of ingot copper, for 1899, gives a return of $^{8}\%_{00}$ of one per cent mineral, and $^{6}\%_{00}$ of one per cent ingot copper—by very far the lowest in the history of the mine. For 1898 the return was 1.41 per cent of mineral. Allowing the rock from the old mine to have averaged as well in 1899 as the rock from both mines averaged in 1898, the Junior would have produced only 263,944 pounds of mineral in 1899, a percentage of $^{2}\%_{00}$ of one per cent mineral, or $^{2}\%_{00}$ of one per cent ingot—four pounds to the ton and less than one-third of the Atlantic's average. As this is manifestly wrong, account must be taken of 378,865 pounds of mass and barrel copper got from the old mine in securing the 40,589 tons of stamp-rock taken therefrom, and which heavy copper is not included in the statement of copper produced by the mine for 1899. Adding this to the estimated production of 1,230,000 pounds of ingot copper from rock stamped gives almost 1,600,000 pounds as the true production of the mine for 1899, which equals 1.11 per cent mineral and $^{8}\%_{00}$ of one per cent ingot copper. Allowing the rock from the old mine to have been no richer than that taken from the Junior, the latter could have returned but $^{6}\%_{00}$ of one per cent, or a little over 13½ pounds of copper to the ton. In all likelihood it was considerably less than that, as the rock from the old mine is richer than that from the Junior, so that one-half of one per cent would probably be a fair figure for the return from the rock mined at the Junior in 1899. This is the lowest return from any producing mine in the district, with the possible exception of the Arcadian, where detailed figures of production are unobtainable. Under ordinary circumstances such a low percentage would mean ruin, but in the case of the Franklin conditions are unusual.

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It is necessary to open the ground in the new mine to determine what is in the rock. After the shafts and drifts are opened, ground can be stoped cheaply, and with copper at 16 to 17 cents, even ten pounds of copper to the ton give $1.60 to $1.70 returns. By charging all opening work to construction account, the Junior would probably show a balance of earnings on one-half per cent rock, though if all expenditures were charged against production, it is hard to see how anything but a deficit could be figured out.

The long-continued litigation between the Franklin and Pewabic companies still lingers in the courts. The Franklin claims about $30,000 from the Pewabic, for pumping charges and cash and supplies advanced, while the Pewabic has a stiff counter-claim of $200,000. The Pewabic has frequently secured heavy verdicts against the Franklin, which have invariably been set aside by the higher courts, and the case remanded down for another trial.

Some experiments directed to securing the copper in the old tailings were made on the old Franklin sands, at Hancock, in the summer of 1900. The Emmons sludge process, successfully used in the Missouri and Kansas zinc fields, was employed in this work and several barrels of fine copper were secured during the experiments. The old sands of the Franklin and of other mines of the district contain tens of thousands of tons of fine copper, much of which may eventually be saved by reworking.

The financial statement of the Franklin company, of Dec. 31, 1899, issued to the shareholders at the succeeding annual meeting, gave assets of $176,002.24, and liabilities of $304,799.58, showing a balance of liabilities of $128,797.34, to offset which there remained in the treasury 20,000 shares of capital stock, the capitalization having been increased to provide the money required for a new mill and the development of the Franklin Junior mine.

The total cost of the new mill was $269,000.12. To Dec. 31, 1899, the cost of the Franklin Junior, including real estate, development, buildings and machinery, was $733,951.63. For 1899 the receipts of the Franklin company were $272,652.67, of which $32,851.28 was from insurance on the old mill; $37,153.58 from the sale of 1,682 shares of capital stock, and $202,647.81 from sales of copper. The expenditures for the year were $595,188.15, showing a balance of expenditures over income of $322,535.48. These figures are hardly just to the company without explanation, however, as the mine was producing for only 4½ months, and the construction charges were $206,119.06, leaving $389,069.09 as the actual running expenses of the property for the year.

The following figures are from the sworn return to the State of Michigan, under date December 31, 1899:

Amount cash paid in on capital stock	$740,333.58
Amount invested in real estate (since 1893 only)	54,901.50
Amount of personal estate	176,002.24
Amount of floating debt	71,799.58
Amount due corporation	30,000.00

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QUINCY.

The Quincy Mining Company was incorporated under a special charter issued by the State of Michigan in 1848, and was reorganized and reincorporated in 1878, upon the expiration of its first period of life, the charters issued mining companies by the State of Michigan running for thirty years only. The earlier mining companies were nearly all organized under special charters, none of which have been issued by the state for many years, all corporations now organizing under the general acts. The Quincy has therefore lived one full life of thirty years and has completed more than three-fourths of its second term.

The main office of the company is at 45 Broadway, New York City. The officers of the company at New York are T. Henry Mason, president; Charles J. Devereaux, vice president; Wm. Rogers Todd, secretary and treasurer; W. A. O. Paul, assistant secretary and treasurer; T. H. Mason, Chas. J. Devereaux, Isaac H. Meserve, Geo. T. Bliss, Cleveland H. Dodge, W. R. Todd and Samuel B. Harris, of Michigan, directors. The transfer agent is the Old Colony Trust Company, of Boston. The number of shareholders of record on Dec. 31, 1899, was 1,540.

Officials at the mine are Capt. Samuel B. Harris, agent; John L. Harris, assistant superintendent; Angus McDonald, clerk (promoted from supply clerk); Thomas Whittle, mining captain; Cornelius Bedell, mill superintendent; C. E. Brackenbury, mining engineer. Mr. T. H. Mason succeeds his father, the late Thos. F. Mason, whose term of office as president began contemporaneously with the Quincy's real career as one of the world's great mines. Mr. Con. Bedell succeeds his father, the late George Bedell, as mill superintendent, and John L. Harris is aiding his father, Capt. S. B. Harris, in the management of the mine—and by his good work, perhaps best shown in the sinking of No. 7 shaft, reference to which is made further on, has shown that he is "a chip of the old block," and capable of successfully performing feats of difficult engineering for which there are no precedents.

The Quincy is as pre-eminently the world's greatest amygdaloid mine as the Calumet & Hecla is the greatest producer from the conglomerate. In 1898 the Quincy ranked fifteenth among the great copper mines of the world, but in 1901 should reach at least twelfth place, and by 1902 should be in ninth or tenth place. The other mines are growing, but the Quincy is likely to grow faster. The careful planning and heavy expenditures of the past three years have been made with a view to increased earnings through large production. There has been much delay in the consummation of the plans, due partly to the accidents and unavoidable delays incident to the conduct of a great enterprise, but more especially caused by the failure of manufacturers to furnish machinery and building supplies when promised. The Quincy has suffered great delay through the boom of the past two years in the iron and machinery trades, but its orders were placed sufficiently early, in the main, to get the benefit of the low range of prices preceding the great activity of the latter part of 1898 and the two following years.

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The Quincy mine is opened on the Pewabic amygdaloid lode, though a little mining was done in early years on the Quincy amygdaloid, a parallel bed. The average dip of the lode is 52 to 54 degrees, running to as flat as 43 degrees at the depth of 4,000 feet in No. 7, the southernmost shaft. The lode averages about 20 feet in width in the old mine and is 10 feet wide in No. 8 shaft, north of the Franklin, on the Mesnard tract, the greatest width of lode in the old mine being about 40 feet. The Pewabic amygdaloid is very uneven in its copper contents, ranging from masses of virgin copper of 300 tons weight, which were found in the upper levels, many years ago, down to rock that is almost entirely devoid of metal. By opening the mine on a grand scale it has been possible for the management to maintain a fairly equable production from year to year. If the stamps were at the heels of the miners, the Quincy would be a Calumet & Hecla some seasons and leaner than the Atlantic in others. The only safety lies in the policy pursued for many years, of having very great reserves opened ahead of the actual requirements of production. About one-third of the product of the mine, taking one year with another, comes in the shape of mass and barrel copper, which goes to the smelter direct from the rock-houses. The remaining two-thirds is copper taken from stamp-rock treated at the mills. The Quincy can go down two miles on its present lands, and is as yet less than a mile in depth.

Owing to the absorption of the Pewabic mine some ten years ago, and the recent opening of the Mesnard tract, the numbering of the shafts is somewhat erratic. The southernmost shaft, a new one, is No. 7, followed by No. 4, 900 feet northward. Next is the man-engine shaft, now abandoned, as all miners are taken to and from their work on man-cars, such as are described in the article on the Calumet & Hecla. No. 2 shaft is 575 feet north of No. 4, and No. 6, North Quincy, (formerly Pewabic) is 1,900 feet north of No. 2. The Franklin mine then intervenes, and on the other side of the Franklin, No. 8 shaft is being sunk on the Mesnard lands, on the outcrop of the Pewabic lode, No. 8 being about 4,200 feet north of No. 6. The Mesnard is merely being scratched at its southern end by No. 8 shaft, and beyond the Mesnard is the Pontiac, carrying the extension of the same lode, each of these tracts being of the same area as the Franklin mine.

No. 7 shaft is the only one of its kind in the world, being sunk on a catenary curve. The angle at which the shaft leaves the surface is 53 degrees with the horizon, while at the bottom, on the 49th level, 4,000 feet below the collar of the shaft, the dip is but 43 degrees. The shaft was started upward, from the 47th level drifted south from No. 4, in December, 1897. The shaft was started from surface in the following May, when the leaving of the snow permitted work there, and was "sunk" in five different sections, one being from surface, one from the bottom, and the other three in raises from intermediate levels. The shaft, 4,000 feet deep, was holed through in the record-breaking time of a trifle over eighteen months. It is 6 x 18 feet in size

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inside of timbers, and a credit to the engineering ability of Mr. John L. Harris, who planned and supervised the work. A fine steel shaft and rock house is just completed, at this writing, Nov. 10, 1900, and is practically a duplicate of the shafthouse at No. 2. It stands 106 feet high, above the collar of the shaft, and is fitted with steam hammer and five Hodge crushers.

The new hoisting engine installed at No. 7 has few equals in the copper district or at any mine in the world. It is a direct-acting Corliss, of Allis build, having 8,000 horse power, with cylinders 52 x 84 inches, and winding drums 28 feet in diameter by 11 feet 9 inches face. These drums are 87 feet in circumference and can carry 8,000 feet of 1¼ inch steel cable. The hoist can elevate a six-ton skip from a depth of one and a half miles at the rate of 3,000 feet per minute, the speed of hoisting being limited to the figure named by automatic governors. The engine is also provided with automatic cut-off, preventing the hoisting of the skips through the head-gear through overwinding, should the engineer become careless or meet with accident. Once started hoisting from the bottom of the shaft, the engine could be left untouched and would check without damage to machinery, skip, cargo or shaft, after raising the skip a few feet higher than the appointed place in the shafthouse. The hoist is of titanic proportions, as befits its power, the main shaft carrying the drum weighing 60 tons. The engine is housed in a rock-faced redstone building, 58 x 94 feet in size.

No. 4 shaft, next northward has long been one of the principal shafts of the mine. It is fully equipped for the work required of it, and is 4,200 feet deep, but will not be sunk deeper, as a new hoist would be required for a greater depth than now reached, and the ground tributary to No. 4 below the 51st level can readily be reached from No. 7, which is equipped for almost any depth. No. 2 has a fine plant, much like that at the new No. 7 shaft. It is the deepest shaft in the mine, being down about 4,600 feet.

No. 6 is the "North Quincy" shaft, formerly owned by the Pewabic company, and is 1,900 feet north of No. 2 and but 200 feet south of the Franklin line. It is 4,450 feet in depth. When the new No. 7 shaft went into commission, a few weeks ago, No. 6 went out of commission. The skip-tracks are being relaid and various improvements are under way, which, when completed, will permit hoisting 6-ton skips in place of the 4½-ton skips formerly used. The men working underground in No. 6 were transferred to No. 7, so that there has been no cessation of production or lessening of forces. When the improvements are completed in No. 6 shaft it will go into commission again, and about 200 new men will be required to man it.

No. 8 shaft is on the Mesnard tract, about 900 feet north of the Franklin line and 4,200 feet north of No. 6 shaft of the Quincy. There were five old shafts on the Mesnard property, all shallow, small and crooked. One of the old shafts was unwatered and the work of cutting down to three-compartment size begun in July, 1899. The shaft is now

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about 600 feet deep, nearly all of which is in virgin ground, and has its first level opened at a depth of 244 feet below surface. Drifting is in progress on three levels, both north and south. The lode, as opened, runs about ten feet wide, or half the average in the Quincy, and is of lower grade than further south, in the Franklin and Quincy, but will pay to mill. An improvement in grade has been noted in the last 200 feet gained in depth. It carries some mass and barrel work, as well as stamp copper. The real value of the Mesnard end of the mine can be demonstrated only at considerable depth. Indications favor the widening of the lode and its quickening in copper as well, at greater depth. At the Mesnard shaft there is a frame building housing the boilers, hoist and compressor. The hoist was taken from No. 2 shaft, and is good for a depth of 4,000 feet. The compressor is of Rand manufacture, with 17 x 24-inch cylinders and is of 12-drill capacity. There are two 80-horse power boilers. The shafthouse is similar to those at Nos. 2 and 6 shafts in design and equipment. The Mineral Range railroad has built spur tracks connecting the shaft and coal sheds with the main line of that road. Eventually the Quincy will extend its own railway to the Mesnard—which can be done on its own lands—when the shaft is ready to begin production.

For some years the production of the Quincy has been mainly from shafts 2, 4 and 6. No. 7 now takes the place of No. 6, but the latter will again become a producer in a few months, and will help to raise the increased tonnage required for the feeding of the new mill. No. 7 has some excellent stopes from the 6th down to the 51st, or bottom level. In No. 4 stoping is in progress between the 18th and 48th levels. Recent examination of the upper levels, untouched for years, has brought to light much good ground. No. 2 is bottomed on the 56th level with stoping ground from the 17th to the 55th levels, inclusive. There are some enormous reserves of good milling ground in this shaft. No. 6, previous to closing down for rebuilding, was stoping from the 41st to 50th levels, with the best ground at the bottom. This is highly important to the Quincy, because on the 45th level the boundary line cuts out the Franklin, giving everything on the lode below this depth to the Quincy. The 45th and 46th levels of the Quincy are drifted well under the Franklin, on their way to join the Mesnard shaft, and the seven levels below the 46th, are all drifting in the same direction. The north drifts on the 45th and 46th levels of No. 6 are already within a few hundred feet of where No. 8 shaft will eventually be bottomed, and may expedite the completion of that shaft by doing considerable raising, on the same plan that No. 7 was "sunk" from the bottom as well as the top.

The southernmost drifts of the Quincy are under the village of Hancock and 3,500 feet below the mean water level of Portage Lake. The northernmost workings, at the Mesnard, are one and a half miles distant from the breasts of the southern drifts, in addition to which there is almost exactly a mile of the Pewabic lode untouched, north of No. 8 shaft on the Mesnard and Pontiac tracts.

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In the way of new machinery and surface work the Quincy has made gigantic strides in the past three years, and in 1899 and 1900 the improvements have been on a truly colossal scale. The mine is literally being made over, on surface, in addition to the great changes in underground development. Near No. 7 shaft are two new boiler plants, each having eight 100-horse power Roberts tubular return horizontal boilers. These furnish power for shafts 4 and 7 and help out No. 2 also. At No. 6 there is a new boiler-house, 56 x 75 feet in size, containing four 250-horse power Wickes water-tube vertical boilers and a powerful fire pump, in addition to the old boiler plant with nine 100-horse power horizontal boilers of the ordinary type.

On the site of the old Pewabic smithy, which was torn down to give the room, a new blacksmith shop 50 x 120 feet in size, with an ell 50 x 92 feet, of redstone finished ashlar, having a truss roof covered with slate and three mammoth ventilators, was built in the summer and fall of 1900. It is now being fitted with 12 forges, fan, steam hammers, bolt-cutters, drills, grindstones, etc., and will be the model smithy of the copper district.

Near No. 2 shaft a new machine shop, of stone, brick and steel, 62 x 145 in size, has been built, replacing the old shop. It has a truss roof and a traveling crane covering the range of the entire shop, and is fitted with the latest and best in lathes, planers and minor machinery. A fire-proof roof has been placed over it, making the building as impregnable to flames as human ingenuity can devise it.

Nearby stands the new compressor house, 53 x 69 feet on the ground, also of stone and steel, with truss roof, housing two of the finest air compressing machines ever built. They are of 60-drill capacity each (doubling the previous drill capacity of the mine) and are Corliss pattern cross-compound two-stage condensing right and left hand machines, made by the Rand Drill Company. They are so connected that air from them is available for use in any part of the mine, even the Mesnard shaft. Being cross-connected, the danger from break-downs is reduced nearly to the zero point.

Connecting the boiler house, compressor plant and machine shop is a tunnel, bricked and plastered inside, which serves as a conduit for the steam and air pipes. A dam has been built for the compressor plant, into which the exhaust steam is sent.

A new coal yard was built in the winter and spring of 1899–1900, between shafts 2 and 4. In 1899 new dwellings were built to the number of 43, of which 25 were at the mine proper, 6 at the Mesnard and 12 at the mill. In 1900 new houses have been put up to the number of 24, of which 12 are at the old mine and 6 each at the Mesnard, and the stampmill. The Quincy mine location is a very neat one, and the streets have the appearance of having been swept every morning. This tidiness appertains to the mine buildings and the millsite; there is a place for everything, and everything in its place. There are a large number of dwellings at the mine, and a con-

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siderable village at the mill, the latter being called Mason, in honor of the late president of the company. The new houses at the Mesnard are all of seven-room size, on solid stone foundations. In addition there is a considerable cluster of older dwellings, dating from the time when the Mesnard was worked in a small way many years ago.

The mine is served by the Quincy & Torch Lake Railroad, which is owned outright by the Quincy Mining company. The road was built in 1890, when the old mill on Portage Lake was abandoned for the new one on Torch Lake, and is about six miles in length from No. 4 shaft to the mill at Mason. This road touches all the shafts and main buildings of the mine, and has connections with the Mineral Range and Hancock & Calumet railroads. The grade is downhill from the mine to the mill, and the line is built and ballasted on the New York Central plan throughout. A number of ravines have been filled with rock from the burrows at the mine, and during 1899 and 1900 all remaining wooden trestles were replaced with steel bridges. One locomotive was added in 1900, giving a total of four engines for the line. Twenty-four new hopper-cars of 19-ton capacity were bought in 1900, making a total of 74 rock cars owned and in use. There are also flat cars for freight and miscellaneous purposes. The new cars were made by the American Car & Foundry Company of Chicago, and have automatic couplers, Westinghouse air brakes and all the modern trimmings. A new stall, 15 x 64 feet, was added to the roundhouse, near No. 7 shaft, to accommodate the new locomotive, and on the other side of the roundhouse an addition 36 x 40 feet was built in 1900, as a special machine shop for the railroad, there being much work which can be done at the roundhouse to better advantage than if taken to the main shops.

The Quincy mill, on Torch Lake, is a wooden structure, erected in 1890, containing five stamps, with other necessary washing and dressing machinery. The mill is now stamping over 2,000 tons daily, giving an average per head per day of upwards of 400 tons. The milling cost per ton for 1899 was 22.19 cents, a fraction of a cent below the cost at the Tamarack mill, giving the Quincy the broom for the district. A generous rivalry has long existed between Captains Harris of the Quincy and Parnall of the Tamarack and Osceola as to milling costs, and it has been a very pretty neck-and-neck race.

At a distance of 630 feet north of the old mill, the Quincy is completing a new mill, of steel throughout. The new building is 130 x 217 feet in size, and is notable for the great number of large windows, there being no less than 180, each with 13½ square feet of glass in its sash. This will give a flood of light in every part of the building, and is an innovation likely to be followed in the construction of other new mills in the district. For night work there is an electric light plant, supplying all buildings at the millsite. The new mill contains three Allis heads, with 20-inch cylinders. The old mill started two stamps in 1890, a third in 1891, and two more, filling the mill's capacity, in 1892.

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The prophets who then went on record with the prediction that the Quincy could not possibly supply five heads are now solemnly averring that the mine cannot supply rock for eight stamps. As before, they are mistaken. The new mill will have a capacity of at least 1,200 tons daily, and when the new stamps start the mine will increase its rock production by at least 40 per cent, and probably by 50 per cent, within a few months thereafter. The foundations for the heads at the new mill are unusually massive, consisting of deep and wide beds of timber and concrete, over each of which there is a bottom-plate of 22 tons, a middle-plate of 18 tons and a top plate of 18 tons, these plates being solid castings of iron. The solidity of the foundations should obviate trouble, even from the blows of stamps having 20-inch cylinders.

A radically new departure in the new mill is the discarding of all finisher jigs and slime tables, and the substitution therefor of Wilfley concentrating tables. The Wilfley concentrators have been tried at a number of mills in this district in the past eighteen months, and have given satisfaction, while at the Quincy their work has resulted in saving about one-third of the copper formerly lost in the tailings, when finishing jigs and slime-tables were employed. They have replaced the jigs used for fine sands at the old mill, ten Wilfleys now being in use doing the work previously performed by 60 jigs. The Wilfleys have been tried on slimes also, with such success that the new mill will have neither finisher jigs nor slime-tables, 24 Wilfley tables taking their place—eight tables to a stamp, thus allotting one table to the fine sands and slimes from about fifty tons of rock daily. The substitution of the new machines for the old style of finishing machinery will result in saving a great deal of floor space, and a large part of the room so saved has been thrown into the space devoted to the rough-jigging machines.

For the new mill a new boiler house has been built, of steel frame on stone foundations, 56 x 90 feet in size. In this are four Wickes vertical water-tube boilers of 250 horse power each, and room for a fifth of the same size, in case it should be needed in the future. The boiler has a steel smokestack 100 feet high on a 30-foot stone foundation.

A new pumphouse has been built at the mill, of brick and steel, 54 x 54 feet in size. In this is a new Allis vertical triple-expansion pump, rated at 16,000,000 gallons daily capacity, and capable of lifting 20,000,000 gallons of water for the mills every day, if required. In the old pump-house there are three pumps having a combined capacity of 21,000,000 gallons daily. A tunnel 7 x 7½ feet inside measurement has been driven under the lake for a distance of 100 feet, and through this water is secured for the new pump. A tunnel 6 x 6½ feet inside, by 440 feet long, connects the boiler house, pumphouse and mills. This is bricked and plastered inside and carries the water and steam pipes.

There is an electric light plant at the mill, also the usual machine shop and minor buildings. There is a good wharf 40 x 216 feet in size, with 18 feet of clear water alongside; also coal pockets, trestles and unloading machinery.

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The Quincy began refining copper in its new smelters on Dec. 1, 1898. The smelts are located on the north shore of Portage Lake, upon the site of the old Pewabic stampmill. The main building is 84 x 144 feet in size, of rock-faced redstone and contains four furnaces. There are the usual buildings, such as casting house, coal shed, cooper shop, engine house, etc., all of the most solid construction and of decidedly pleasing appearance architecturally. The four furnaces have 75-foot stacks and the entire plant is strictly modern. There is a shipping wharf 350 feet long lying parallel with the main channel of the lake, also a coal wharf 250 feet in length. The entire plant was planned by Mr. Jas. R. Cooper, the superintendent, who has spent nearly forty years learning the smelting business, and is an authority on every branch of the work. The plant has given the best of satisfaction from the first, and has saved about $1 per share per annum to Quincy stockholders during 1899 and 1900.

Half a mile west of the smelts, the Quincy rebuilt, during 1900, the old wharf formerly used by the mill that was torn down ten years ago, and has erected a large frame warehouse thereon. This has rail as well as water connections and is a great convenience and money-saver. The coal consumption of the Quincy is now about 60,000 tons per annum, and the bulk of the coal receipts come via Portage Lake, to save the tolls charged on cargoes entering Torch Lake.

Water for the boilers and mine location is forced from Portage Lake, the elevation being about 640 feet in the distance of one mile between the pumphouse and No. 2 shaft. The pumping station is an ashlar redstone structure, standing on the site of the original Quincy mill.

In the fall of 1900 the Quincy company platted that portion of its land known as Shantytown, and lying just north of the village of Hancock. The lots are within a few blocks of the principal business streets and are in good demand at good prices. The platting of this addition will not only add materially to the revenues of the company, but will greatly improve the town.

The following table, covering certain statistics of the Quincy for a third of a century, is from the report of the United States Geological Survey, except the figures for 1899, which I have added to bring the table to date:

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Year.	Product.	Yield fine copper per fathom broken.	Price obtained.	Cost per pound, exclusive of construction.	Number of miners	Average monthly contract wages.
	Pounds.	*Pounds.*	*Cents.*	*Cents.*		
1864.....	2,498,574	562	44.8	26.7	242	$65.50
1865.....	2,720,980	501	....	....	212	57.53
1866.....	2,114,220	451	31.3	29	227	53.16
1867.....	1,921,620	526	22.7	18.9	167	50.83
1868.....	1,417,941	447	25.2	23.1	157	50.44
1869.....	2,417,365	446	21.9	16.7	210	51.10
1870.....	2,496,774	528	21.5	15.3	181	46.09
1871.....	2,409,501	441	22.8	15.2	104	47.08
1872.....	2,269,104	391	32.5	22.9	233	60.62
1873.....	2,621,087	491	26.5	18.6	223	62.42
1874.....	3,050,154	577	21.9	15.1	234	43.38
1875	2,798,281	485	22.7	15.8	217	46.74
1876.....	3,073,171	507	20	15.7	227	47.13
1877.....	2,837,014	467	18.6	15.1	247	43.79
1878.....	2,991,050	395	14.9	14	234	41.50
1879.....	2,639,958	403	16.3	13.7	212	38.76
1880.....	3,609,250	563	18.5	11.8	192	49.10
1881.....	5,702,606	767	18.7	10	212	48.54
1882.....	5,682,663	800	17.1	9.5	152	48.83
1883.....	6,012,239	850	13.7	8.9	165	46.02
1884.....	5,680,087	722	12.2	8.6	157	43.35
1885.....	5,848,497	710	11.4	7.5	132	44.00
1886.....	5,888,517	638	11.1	6.8	140	45.80
1887.....	5,603,691	781	11.7	8.6	142	48.40
1888.....	6,367,809	690	15.9	10.1	158	49.60
1889.....	6,405,686	690	12	9.4	145	49.15
1890.....	8,064,253	769	15.7	8.2	146	52.60
1891.....	10,542,519	685	12.8	9.1	182	53.40
1892.....	11,103,926	572	11.27	8.8	238	53.75
1893.....	14,398,477	574	10.4	7.1	259	49.60
1894.....	15,484,014	584	9.5	5.7	285	50.70
1895.....	16,304,721	517	10.1	5.9	336	50.00
1896.....	16,863,477	477	10.9	6.5	379	52.00
1897.....	16,924,618	481	11.1	6.8	393	52.52
1898.....	16,354,061	513	12	6.8	381	52.50
1899.....	14,301,182	427	17	8.1	401	56.72

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Following is a summary of the very full and clear financial statement issued to shareholders at the last annual meeting. It is of date Dec. 31, 1899:

Copper, 14,301,182 lbs., sold for		$2,450,178.66
Running expenses at mine....	$ 969,741.09	
Construction account.....	404,481.09	
Taxes, in Michigan.....	40,117.06	
	$1,414,339.24	
Smelting, transportation and all other charges.....	153,752.08	
		$1,568,091.32
Leaving as mining profit.....		$882,087.34
Receipts from interest.....		13,361.08
Receipts from Hancock real estate		33,218.57
Making net income for year 1899.....		928,666.99
Balance of assets, Jan. 1, 1900.		$1,207,942.14

The total receipts of the Quincy Mining Company, from its organization in 1848, until and including Dec. 31, 1899, were $38,569,253.71. For the same period, dividends were $11,070,000.00 and balance on hand was $1,207,942.14; while expenditures for all purposes were $26,291,311.57. of which the largest item, amounting to $22,571,526.64, was for labor, smelting, transporting and marketing copper, and general office expenses. The expenditure for real estate, buildings, mills, machinery, railroad and equipment, wharves, etc., was $3,611,186.95. This gives nearly 32 per cent of gross earnings as net profit, in addition to which there is the mine, worth upwards of $15,000,000, basing its value on the present selling price of its shares.

Following is a summary of the sworn statement returned to the State of Michigan, under date Dec. 31, 1899:

Amount of cash paid in on capital stock....	$1,500,000.00
Amount paid in by conveyance of property.	1,000,000.00
Amount invested in real estate.....	.....
Amount of personal estate.....	1,161,893.87
Amount of floating debt.....	464,208.52
Amount due corporation.....	.....

(Quincy Mining Company, organized under special charter March 30, 1848, dissolved its organization March 6, 1878, and new company of same name organized under mining laws of State of Michigan with 40,000 shares of par value of $25, same being estimated cash value of the property. On June 5, 1889, capital stock increased to 50,000 shares. On June 3, 1896, capital stock increased to 100,000 shares, increase taking effect April 16, 1897. The scrip issue was used for purchasing mineral lands adjoining the mine.)

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The total production of refined copper by the Quincy mine to the close of 1899 was 246,968,382 pounds, which was sold for $36,657,606.95, including the silver produced therewith. Receipts from capital stock have been $200,000, and from sale of scrip (to shareholders), $1,250,000. From sundry investments the company has received profits of $79,637.16, in addition to the return of the principal, and from interest, the receipts for all years have been $271,071.81. From real estate sold in Hancock receipts have been $110,937.79.

For the year 1899 the company employed an average of 1,355 men, of whom 401, or 30 per cent, were miners. The wages of miners on contract averaged $56.72 per month for the year—the highest wages paid since 1873. In 1899 the yield of mineral per fathom of ground broken was 534 pounds; yield of ingot copper per fathom of ground broken, 427 pounds—the lowest since 1879. The rock mined amounted to 602,409 tons; rock hoisted was 586,820 tons; rock milled, 559,164 tons. Of the production of 17,866,680 pounds of mineral, 4,427,475 pounds were mass and barrel copper secured at the rock houses, and 13,439,205 pounds were mineral obtained from stamp rock at the mill. This is the smallest proportion of heavy copper secured for many years.

For the year 1898 the production of mineral was 20,056,942 pounds, yielding 16,354,061 pounds of refined copper, produced from 543,592 tons of stamp-rock; for 1899 the production was 17,866,680 pounds of mineral, yielding 14,301,182 pounds of refined copper, from 559,164 tons of stamp-rock. In 1898 the return of ingot copper per ton stamped averaged 1.51 per cent, and for 1899 the average return was 1.27 per cent, a falling off of 24/100 of 1 per cent, or 4.8 pounds per ton. The mineral produced in 1898 averaged 81.5 per cent copper, and for 1899 80.5 per cent refined copper. At this ratio for 1899, the 13,439,205 pounds of mineral produced at the mill were equivalent to 10,818,600 pounds of ingot copper. As this was secured from 559,164 tons of rock stamped, the net return from the mill was equal to 9%00 of one per cent ingot—the lowest in the history of the mine, though the year was one of the most profitable.

A taste for making figures is a dangerous one, unless held in careful check. It is a very easy matter to sit down and produce irrefutable evidence—on paper—from the exhaustive reports of the Quincy, that the mine is going to the demnition bow-wows as rapidly as possible. The logic of the figures is irrefutable—on paper. As a matter of fact, the figures are misleading—the Quincy was never so great, so prosperous or with such excellent prospects as today.

On their face, the figures so freely furnished by the management tell a story of increasing mining and general costs and of increasing construction account; on the other hand, decreasing production and decreasing richness of the rock. The use to which the figures furnished by the company have been put by irresponsible mathematicians affords some excuse for the secretiveness manifested by the Tamarack, Osceola, and Calumet & Hecla, which give their shareholders practically no information at all, further than that good dividends have been

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paid and that there is reason to believe that such will continue to be paid for some time to come. The four unfavorable items relating to the Quincy are all readily explainable. The general increase in cost of labor and material of all kinds is due to the advance in wages, fuel, machinery, and supplies of all kinds—but the advance in costs is far more than offset by the increase in the selling price of the product of the mine, from 9 cents in 1896 to an average price of 17 cents realized for every pound of copper made by the mine in 1899. The heavy increase in construction account means that the management is wise enough to put some of the profits back into the mine, during a period of unparalleled prosperity, The construction account has been a heavy one for several years past, and is likely to prove fully as large for 1900 as in 1899, but in return for this great outlay, the Quincy shows the lowest milling costs of any Lake Superior copper mine in 1899. It has opened a great deal of new ground and has practically replaced its entire surface equipment, both buildings and machinery, in the past four years. The new equipment is on the Calumet & Hecla scale; it will stand comparison with any mining and milling plant in any mining field of the old or new worlds. A new mill is nearly ready to begin work, and the mine will show an increased production for 1901. The decreasing richness of the rock is more seeming than real. The mine is certainly not as rich in very heavy masses as it was at shallower depths, many years ago, but the big dividends have nearly all been earned from the sort of rock that the Quincy now shows in scores of stopes on the mile and a half of horizontal length that the mine is opened. In 1899 the management took advantage of the sustained high price of copper to clean out many old stopes left because of low values in former years. Such ground can be milled at a handsome profit with the metal at 17 cents, but would be worthless on a nine-cent copper market. It was also desired to open more stopes, in view of the large increase of production planned for the opening of the new mill. The Quincy is and always has been a bunchy mine, and requires a vast deal of ground opened ahead to allow a selection that will hold the production at all regular. There are more than thirty miles of drifts in the Quincy; not half a dozen men living have been all through the mine. Some fine stopes opened in the past two years are untouched. They will bring less money to shareholders if milled in some future year with copper at a low price than if stamped now—but they will keep the dividends going when times are blue in the copper world. The Quincy mine is known at Lake Superior as "The Old Reliable," and it merits the title. It is a bigger, richer and every way better mine than ever before in its long and honorable history. It made copper for less than 6 cents per pound in 1894 and 1895, and can meet any price that any other mine can make in the future—and pay dividends withal.

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ISLE ROYALE.

This mine is owned and operated by the Isle Royale Copper Company, which was incorporated under the laws of New Jersey, in April, 1899, with a capitalization of $3,750,000, divided into 150,000 shares of the par value of $25 each. On April 20, 1899, this corporation took over the assets and entire business of the Isle Royale Consolidated Mining Company and the Miners' Copper Company, both of which corporations were organized under Michigan laws, the former in 1897 and the latter in 1898, each with capitalizations of $2,500,000. Each of the corporations merged in the present Isle Royale company had a cash treasury fund of one million dollars, after acquiring title to lands, on beginning corporate existence. This gives the present Isle Royale Copper Company a larger sum in hard cash for developing a mine than has ever before been furnished any one copper mine in the Lake district.

The main office of the company is at 199 Washington street, Boston, with A. S. Bigelow president and W. J. Ladd secretary and treasurer. Capt. Wm. E. Parnall, of Calumet, is superintendent, and R. M. Edwards, who is in immediate charge, is assistant superintendent. Mr. Edwards was for some years mining engineer of the Tamarack and Osceola properties, and has earned his promotion by merit. H. D. Haddock is clerk; Edward Warmington mining captain; A. L. Burgan, formerly assistant superintendent at the Tamarack and Osceola mills, is in charge of the Isle Royale mill, and James E. Richards is master mechanic.

The present Isle Royale includes the mines formerly known as the Isle Royale, Grand Portage, and Huron, which comprised the original Isle Royale consolidation in 1897, and also the prospects known as the Frue and Dodge, lying south of the Huron, which were taken into the Miners' consolidation late in 1898, and adjoining mineral tracts on which no development has ever been made. The area of the tract is 3,240 acres, all on the mineral belt. The property comes very close to the Eastern Sandstone at the northeast corner of the tract. The real estate includes all of Sections 1, 2 and 11, and parts of Sections 3, 9, 10 and 15, in Town 54 North, Range 34 West; also 160 acres in Section 6, 54-33; 40 acres in 31-55-33 and 160 acres in 36-55-34. In area it is second only to the Arcadian among the active mines of the Lake district.

The old Isle Royale mine was opened in 1852, the mine taking its cognomen from the title of the corporation, which was originally formed to operate on the island of that name. The work on this property was the first mining done in the Portage Lake district. Three parallel amygdaloid belts, lying about 200 feet apart, were opened, and mining begun on the middle lode, which was marked by a line of Indian pits for nearly a mile along the outcrop. This stratum is now known as the Isle Royale amygdaloid, and is frequently termed the Isle Royale epidote, from the great amount of epidote carried, the greenish color of this mineral being a marked characteristic of the lode. The western

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lode of the three is known as the Portage, having been opened by the Grand Portage mine. The eastern lode has been explored but little; it carries some copper, but is apparently of no great promise. In addition there is the "Mabbs Vein," opened by the Mabbs Brothers, during the time they last had the mine on tribute. This is little known, and it is not certain whether it is a fissure vein or an amygdaloid of the true stratified formation. It is narrow, running 4 to 7 feet wide, but very rich in mass, barrel and stamp copper. It was opened to a depth of three or four levels only, by the Messrs. Mabbs. There are also unidentified and unexplored cupriferous amygdaloids lying west of the Portage lode, these having been cut at various times by street work and excavations in the village of Houghton, lying just north of the mine.

In 1853 a mill having eight stamps of the old gravity pattern was built, and the number of stamps doubled in 1854. In 1856 the mill was enlarged to forty stamps. The company stopped work in 1857 and the mine was leased, on tribute, to Messrs. John and Austin Mabbs. The company resumed control of the mine in 1863, and again stopped in 1870, leasing the mine once more to the Mabbs brothers, who worked it for some years. The last production was made in 1882, and amounted to only a few tons. No less than ten shafts were sunk on the Isle Royale lode, beside two on the "Mabbs Vein." The lode averaged 15 to 20 feet wide, and carried a large proportion of heavy copper. For 1880 the rock stamped returned 9 per cent mineral, equal to about 7 per cent ingot copper, the rock so stamped being very carefully selected. For years unemployed miners living on the location made frequent incursions into the old burrow piles of waste rock, and secured enough heavy copper therefrom to earn day wages. The early mining and milling were done on very crude lines. About one million dollars was sunk on the Isle Royale by various owners, in thirty years.

The Grand Portage mine was north and west of the Isle Royale, and contained 800 acres originally. The mine was opened on both the Grand Portage and Isle Royale amygdaloids, twin strata separated by 200 feet of trap rock. The Portage Mining Company begun work in 1853 and was reorganized as the Grand Portage Mining Company in 1860. This corporation becoming bankrupt, the property was sold to Peter Ruppe, of Hancock, in 1879, and by him transferred to the Isle Royale Consolidated company in 1897. There were three shafts on each lode, which ran 10 to 40 feet in width, where opened. There was apparently no great difference in the value of the two lodes at that point, though there was probably a little more copper in the Isle Royale bed. On the Isle Royale lode three shafts were sunk, two to the fourth and one to the sixth level. The deepest of the three shafts on the Portage lode was down a trifle less than 500 feet. The Portage bed was wider than the Isle Royale, but not so evenly mineralized, the copper being found mainly in a few feet next to foot and

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hanging walls, with the lode almost or quite barren at most points between. Both lodes were very bunchy, and showed alternations of very rich rock and barren ground.

The Huron mine was opened on the tract south of the Isle Royale in 1855, and has been much the largest producer of the three mines opened on the Isle Royale lode south of Portage Lake. Upwards of one million dollars in all has been lost in the operation of the Huron, though in the hands of tributors it made money for years. The company was reorganized in 1880 as the Huron Copper Company. The last production of the mine was made in 1893, it having produced upwards of 600 tons of refined copper in the last fifteen months of operation, under the management of Mr. Graham Pope. Mr. Pope estimates that the mine will give very close to one per cent ingot.

No less than ten shafts were opened on the Huron, these being numbered from north to south. In No. 10, the southernmost shaft, the lode runs as wide as 80 feet in places. No. 8, the deepest shaft, is down 16 levels, or about 1,000 feet. The mine has been extensively opened under a considerable length of ground. Long stretches were left untouched underground, and about half of the rock raised was discarded on surface, the rock milled averaging about 2 per cent mineral. A much closer milling would be made under modern practice, with a mill equipped to handle large quantities of material at low costs. It is possible that it may be found profitable to mill a considerable portion of the old rock burrows of the Huron, Grand Portage and Isle Royale mines, as the rock could be loaded by steam shovels, transported to the mill and dressed there for considerably less than a dollar per ton, and six pounds of copper being worth exactly one dollar, at this writing, October 20, 1900, the burrows might be made to pay. About 15 per cent of the Huron's product was secured in the form of mass and barrel copper, the mine having yielded some fine masses of many tons weight.

The Frue and Dodge, south of the Huron, are mere explorations, where copper was found in pits bottomed on the Isle Royale lode, in the late sixties and early seventies. Neither has produced copper, beyond specimens of barrel work. The adjoining tracts, to the south and west, which were included in the Miners' company in 1898, are on the mineral belt, and probably carry copper, but have never received exploration, further than that casually given in the work of the Michigan Geological Survey, which is interested in mapping the strata, rather than in locating copper-bearing lodes.

The Isle Royale company has a long-term option on the mineral rights underlying the Montezuma tract, in West Houghton, which has about 250 acres, including the area under the southern half of Portage Lake, fronting the Montezuma lands.

The production of refined copper by the various mines comprised in the Isle Royale has been as follows:

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Mine.	Tons.	Lbs.
Huron	17,883	225
Isle Royale	4,602	71
Grand Portage	1,741	294
Total	24,226	590

The total amount of copper taken from the Isle Royale mines is about equal to the present annual production of all the mines of the Lake district, with the exception of the Calumet & Hecla. Its value at the present market price would be about $8,000,000, and its market price, when mined, was probably nearer $12,000,000. There was lost, in opening the mines and producing this amount of copper, about $2,500,000, in addition to the value of the product. The present company should be able to produce copper at an average cost between one-third and one-half of the actual cost of production in previous years.

On December 31, 1899, the company had on hand a surplus of $1,486,449.09, less $599,140.52 deposited with the Globe National Bank, of Boston, which failed in December, 1899. The former president of the bank is now serving a ten-year sentence for embezzlement, in the Greenfield penitentiary. The receiver has already paid 40 cents on the dollar to depositors, and an additional dividend of 10 per cent will be paid before the end of this year, with fair prospects of considerable additional salvage. Mr. A. S. Bigelow, president of the Tamarack, Isle Royale and Osceola companies, has been censured by shareholders for having a portion of the funds of these corporations deposited in the Globe bank. As he personally lost about four times as much as the three mining companies will lose collectively, the censure is unjust. The writer, having been a depositor in the Globe National, speaks with knowledge.

The total expenses of the Isle Royale for the period from April 20, 1899, when the present corporation took over the assets of the Isle Royale Consolidated and Miners' companies, until December 31, 1899, amounted to $330,677.51. This is a large amount for a new property to spend, but the company has been doing much work, and has a fine amount of development, underground and on surface, to show for the cash paid out.

The Isle Royale mine, as at present constituted, has two miles north and south on the mineral formation, which gives very nearly two and one-half miles on the outcrops of the Portage, Isle Royale and other cupriferous lodes coming to surface on the company's lands. It would be possible to open a mine on the Isle Royale lode two and a half miles on surface by almost equal depth, on the company's present holdings. No other Lake Superior copper mine could open a mine of similar dimensions on its lands. The strike of the formation is about North 62 degrees East, and the dip, at the northern end, where the work is now being done, averages 56 degrees, to the west of north-

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west. Judging from developments at the Baltic, the next mine south of the Isle Royale, the dip will be sharper at the southern, or Miners' end, of the Isle Royale lands.

Actual mining work on the consolidated property was begun in August, 1897. This proved tedious, expensive and unsatisfactory, for some months. There were no reliable maps of the old workings, tributors having robbed the upper levels. It was unsafe to sink new shafts until some definite knowledge had been secured of the extent and direction of the old openings, as the bottom might drop out of a new shaft at any time. A start was made, however, at unwatering and cutting down three of the old shafts, one of which was abandoned at slight depth. The present No. 1 shaft is really opened behind the old No. 1 Isle Royale, and the present No. 2 is the old Isle Royale No. 8, cut down to larger size, retimbered and sunk below the bottom of the old mine. No. 1 is near the northern end of the company's lands, and No. 2 is 2,280 feet southward. The old No. 1 shaft had a very flat pitch, running into the hanging wall at an angle of about 45 degrees. The present No. 1 descends at an angle of 56 degrees, which is also the angle at No. 2 shaft. The old mine had been robbed above the adit level, even the shaft pillars having been removed. Descending in such ground was slow and dangerous work, but was accomplished safely, though at a snail's pace for the first few hundred feet below surface, it being necessary to build massive masonry pillars to hold the shafts at a number of points where the pillars of rock had been gouged out by the tributors, who followed copper wherever it went, and cared nothing for the future of the mine. The shafts are in virgin ground below the tenth level, and progress has been much faster since the old workings were safely passed. There has been some trouble with water, which was damned up at various points underground, but there fortunately has been no loss of life, though some narrow escapes, and this danger is now past.

At the present writing, No. 1 shaft has just reached the 14th level, with No. 2 sinking for the same level and but fifty feet short of the depth of No. 1. In the way of new levels there are drifts opened as follows from No. 1 shaft:

900 feet north and 800 feet south on the 7th level;
800 feet north and 800 feet south on the 8th level;
800 feet north and 700 feet south on the 9th level;
850 feet north and 750 feet south on the 10th level;
900 feet south on the 11th level;
850 feet north and 875 feet south on the 12th level;
225 feet north and 250 feet south on the 13th level.

Openings are as follows from No. 2 shaft:

1,075 feet south on the 9th level;
975 feet south on the 10th level;
1,000 feet north and 900 feet south on the 11th level;
700 feet north and 700 feet south on the 12th level;
200 feet north and 200 feet south on the 13th level.

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This gives 8,800 feet of new levels from No. 1, and 5,950 feet from No. 2 shaft, a total of 14,750 feet of new drifts, equal to nearly three miles, in addition to which there is over half a mile in the two shafts and a winze is being sunk between the eighth and ninth levels south of No. 2 shaft, for ventilation. This gives a total of about 3½ miles of new openings, in addition to probably two miles of old openings on the old Isle Royale mine. No attention is being paid to the old openings at present, but they will be investigated later, and will unquestionably afford a number of good stopes. At the present rate of progress underground it is safe to state that the Isle Royale will have nearly five miles of new stoping ground opened when the mill begins work next summer. In addition to the openings on the old Isle Royale, there are about five miles of old levels opened in the Huron mine, as yet untouched by the present management. Much of this has been stoped, but there were long stretches of ground left as worthless which could be mined at a fine profit with the Isle Royale's present equipment. As the Huron is probably of about the same richness as the old Isle Royale, on which the new mine is being opened, and nearly 18,000 tons of ingot copper were secured from stoping five miles of drifts, an extent of opening about equal to what the Isle Royale will have when its new mill starts in the early summer of 1901, it is apparent that the new mine if averaging only as rich as the Huron, will have a large amount of copper in sight. It must also be taken into consideration that the Huron left a great deal of ground that would now be mined, and that a large percentage of the rock was discarded after hoisting, much of which would now be milled. It is probable that with present-day methods 20,000 to 25,000 tons of copper would be secured from the ground that actually yielded less than 18,000 tons, in the past. A very conservative estimate of the amount of copper that will probably be in sight in the new Isle Royale openings, when the mill starts, would be 12,000 to 15,000 tons.

The two shafts will be connected on the eleventh level in a short time, the drifts now being only 380 feet apart. The eleventh was the first level safely below all the old workings, old No. 5 shaft having been sunk to the 10th level, and old No. 8—now No. 2—being below the eighth level. The old workings of the Isle Royale contain a little over two miles of drifts, and the shafts were sunk so closely that a longitudinal section of the old mine looks like a map of New York city, the shafts, running up and down, corresponding to the avenues, and the drifts standing for the cross-town streets so thickly set in the city. It may be remarked, in passing, that some of the old mines of the district had shafts and levels almost as crooked, erratic and perplexing, as the streets in the older section of Boston. The modern mining practice is to sink shafts far apart, each of great capacity and capable of caring for all the rock possible to mine from a large section of ground. Shafts are expensive to open and afford no stoping ground, as solid pillars of rock must be left to support them on all sides. They are necessary in the opening of a mine, but the money is made from

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the drifts. Not only do the shafts afford no stoping ground, but a large amount of lode rock must be left unmined, to afford solidity and safety.

The two shafts of the new mine have been cut down to 3-compartment size, through the old workings, and continued of the same size below the bottom of the old mine. They are straight, well timbered and with skip tracks laid with rails weighing 45 pounds to the yard. There are but two shafts opened on the new Isle Royale, yet they are of a size and equipment giving them a greater capacity than all of the 28 old shafts opened on the Isle Royale, Grand Portage and Huron mines. A third shaft is to be started in the spring of 1901; this will probably be located between 2,000 and 3,000 feet south of No. 2, the exact location not having been decided upon yet.

The lode, as opened by the new shafts, is decidedly bunchy. There are stretches of ground of little or no value, followed by patches of rock carrying copper so thickly that it is difficult to find places for drill-holes. The richest ground so far encountered is at the end of the twelfth level south, in No. 2 shaft, where the rock will probably run 10 per cent ingot. The lode carries mass, barrel and stamp copper, not so much heavy copper as the Quincy, and perhaps not so much as the Osceola, but a considerable amount notwithstanding.

A winze is being sunk between the eighth and ninth levels south, in No. 1 shaft, mainly to secure better ventilation. In view of the long stretch between the shafts, similar winzes will probably be sunk between the levels opened below the ninth.

The equipments at the shafts are duplicates in all essential features. The combination shaft-houses and rock-houses are 44 x 60 feet in size on the ground by about 90 feet high, and are fitted with exceptionally heavy crushers, made by the Portage Lake Foundry and Machine Works, the large crushers having 18 x 24-inch openings, and the smaller ones 13 x 20-inch openings, the large crushers being the heaviest ever built. Coal trestles with storage capacity of 3,000 tons each have been constructed at both shafts. Twenty-five power drills are in use in the mine, and the number will be increased when stoping is begun. There are 35-drill compressors at each shaft; these being compound two-stage machines, of Nordberg make. The engine houses, which cover hoists and compressors, are 50 x 90 feet in size, built of steel on stone foundations. The hoists—duplicates—have 32 x 72-inch cylinders with 72-inch stroke. The drums are 18 feet 6 inches in diameter, with lathe-turned grooves for 6,000 feet of one-and-one-half inch steel cable, and are built to hoist six-ton skips from a depth of 6,000 feet.

The boiler houses are 44 x 72 with coal storage additions 16 x 72 feet. In each are three Burt boilers, horizontal type, with 84-inch shells, rated at 150 horse-power each. There is room for additional boilers, when required.

A new machine shop, 40 x 60 feet, steel frame on stone foundations, was started in the fall of 1900. It will be fitted with a full equipment of tools required for heavy mining work.

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A dam to impound feed-water for the boilers has been made at No. 2 shaft. It is 300 x 500 feet in area, and six feet deep.

A number of new dwellings have been built for employees, at the mine and also at the mill. The company was fortunate in having a large number of old houses on its various mining locations, most of which have been made comfortable and are now occupied. A considerable number of new dwellings will be required in the next two or three years, both at the mine and at the millsite. The village of Hurontown stands on the company's tract, and Houghton is distant less than a mile. Many employees prefer building their own homes, which relieves the company from the necessity of constructing dwellings that would otherwise be required.

The marked growth of the village of Houghton renders it probable that the Isle Royale company can sell considerable land, eventually, for building purposes. The new trolley line of the Houghton County street railway will climb the hill to Hurontown, when the population warrants, as it now ascends the opposite hill to the Quincy, Franklin and Arcadian mine locations, where there are some six or seven thousand people.

The Isle Royale Railroad connects the mine and mill. It was built by the Isle Royale company, and has an easy grade for the distance of four miles of main line. It has two locomotives, one of 35 and one of 55 tons, also 40 steel rock cars of 40 tons capacity each, fitted with air brakes. The railroad touches both shafts, and the shops at the mine, and reaches the mill and wharf at the millsite; it is also connected with the Duluth, South Shore & Atlantic Railway. The Isle Royale was compelled to haul all supplies up a road having grades as high as 700 feet to the mile, before this railway was built—one reason why so much money was sunk in operating the old mines.

The millsite consists of 80 acres, at the mouth of the Pilgrim river with nearly a mile frontage on Portage Lake, at the junction of the Grand and Little Portages. The mill is of steel frame on a stone foundation, 134 x 210 feet in size. It contains all of the advanced ideas found in the Tamarack and Osceola mills, and will do good and cheap work. It would have been completed before this time, but for delays in delivery of machinery and material. It should go into commission about July 1, 1901, barring unforeseen delays. It contains three Nordberg stamps, with the circular mortars and ⅝-inch screen-openings found in the new Osceola mill. These stamps are calculated to treat 500 tons each, daily, and will probably do about 10 per cent better than the estimate. The jigs are all of the Parnall-Krause design which has given such satisfaction at the Osceola mills, and are being made by the Portage Lake Foundry & Machine Works, which concern is also casting the iron-work for the stamp foundations, and the mortar-boxes for the stamps. The mortar-boxes weigh 22½ tons each, being the heaviest castings ever made in the copper district. Including the bed and top plates, anvils and mortar-boxes, each stamp will have about 100 tons of

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cast-iron under it. The foundations for the stamps are unique. Instead of the customary concrete foundations, steel caissons have been sunk to bed-rock for each stamp. These caissons are 12 feet in diameter by 70 feet long, made of ⅝ inch boiler steel, filled with concrete, the weight of each caisson, as filled, being upwards of 500 tons. If the stamps of the Isle Royale mill are not solidly supported, it will be useless to look for solidity anywhere.

At the rear of the mill is a steel boiler-house, 46 x 72 feet in size. This contains four 250-horse-power boilers.

Water for the mill will be furnished by a Nordberg Corliss pump, a duplicate of the pump at the Arcadian mill, of 16,000,000 gallons daily capacity. It can furnish water for six heads, double the present milling capacity. It has a triple discharge into a 30-inch water main, of steel, riveted, which runs 2,200 feet from the pump-house to the mill, the former building being located some distance from the mill, to avoid difficulty from stamp-sand clogging the intake. A separate boiler house for the pump has been built near by, this containing three 100-horse-power boilers. A large coal trestle has been erected at the rear of the boiler-house at the pump-house.

A small creek emptying into the lake has been dammed near the mill, to supply water for the boilers.

A wharf 32 feet wide by 600 feet long has been built at the millsite. This has deep water alongside and will require very little dredging. It is fitted with every appliance for quickly unloading coal cargoes from lake vessels, and for the receipt of general freight, and dispatch of mineral from the mills, which will be taken just a mile, by water, across Portage Lake, to the smelters at Dollar Bay.

The mine is now employing about 250 men, all told. This force will probably be doubled when the mill goes into commission, and if the mine makes good its present promise, will increase steadily for some years to come.

It is impossible to predict what percentage of ingot copper the mine will secure from the rock stamped. There is too much uncertainty as to what grade of stamp-rock the line will be drawn at. It may yield one per cent ingot, and can easily be made to do so, but it is a question whether the management may not deem it advisable to mill a large quantity of low-grade rock, which can be cheaply secured and made to pay with copper at 15 cents or better. Two stamps should be running by next July, and they will treat upward of 1,000 tons daily. The third stamp should be running before the close of the year, bringing the milling capacity up to nearly or quite 1,600 tons daily. This is a tremendous amount of rock, being as much as the Quincy was milling only a few years ago, and more than the Osceola proper is now milling. A one-half of one per cent mine would not pay to open, unless under most exceptional circumstances, but one-half of one per cent rock found beside richer rock in a large mine with a modern mill can be made to pay with copper at 16 to 17 cents. One-half of one per cent

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ingot means 10 pounds of refined copper from a ton of rock. The only sound plan of considering rock of this grade is to treat it as a by-product. It would ordinarily be left in the mine as worthless, and if mined and milled it should not be charged with any portion of the general mining or office burdens, but be considered purely as a by-product and charged with only the actual ton-cost of mining, milling, smelting and marketing. A fair estimate of the costs of making copper from one-half per cent rock would be as follows, in the case of the Isle Royale:

Cost per ton of rock,	Cents.
Stoping	35
Tramming, hoisting and rock-house	25
Transportation to mill	05
Stamping	25
Smelting, transportation and marketing	15
Total	$1.05

As per contra, 10 pounds of copper at 16 cents would be worth $1.60, showing a net profit of 55 cents per ton. Allowing that the Isle Royale can furnish 1,000 tons daily of good selected rock, averaging one per cent ingot, or thereabout, an extra five hundred tons averaging one-half of one per cent might be furnished from the leaner stopes for the third stamp. Stripping operating costs to actual expenditures for the mining, milling and smelting of the 5,000 pounds of copper possible to secure daily from 500 tons of one-half of one per cent rock, the third stamp could net 5 to 6 cents per pound from this 5,000 pounds secured daily from lean rock—a profit of $250 to $300 per diem, equal to 50 to 60 cents per share on the capitalization of the company.

The foregoing figures on lean rock are exclusively my own—the management of the mine is in nowise responsible for them—but they are fair, and are based on solid fact. It is because these figures seem reasonable to me that I do not look for the Isle Royale to average one per cent copper for 1901. Such a return can easily be secured, if desirable, but there will probably be a larger profit in ripping out pretty nearly everything between the walls of the mine, and stamping it wholesale. The eastern and local management of the mine is experienced; it is in the copper business for a profit, and if there is an opportunity, as there promises to be, to make more money out of rock averaging 65 to 75 one-hundredths of one per cent ingot that can be gained from rock running above one per cent in refined copper, and at the same time save fine stopes for the future, and open rich ground against the rainy day that will surely come sometime, I credit the management with sufficient perspicacity to make the Isle Royale a low grade mine in 1901, reserving the right and ability to make it a higher grade producer when future requirements call for a larger return of copper per ton of rock.

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ATLANTIC.

The Atlantic mine is owned and operated by the Atlantic Mining Company, organized under the mining laws of Michigan in December, 1872, with a capitalization of $1,000,000, divided into 40,000 shares of the par value of $25 each, all issued. There were 373 shareholders of record on Dec. 31, 1899. The eastern office is at 11-13 William street, New York City. Annual meetings are held on the second Tuesday in March.

Joseph E. Gay is president, and John Stanton secretary and treasurer. The directors are Messrs. Joseph E. Gay, John Stanton, John R. Stanton, Wm. C. Stuart, J. Wheeler Hardley, Wm. A. Paine, and Samuel L. Smith, of Michigan. Local officials are Frank McM. Stanton, agent; A. D. Edwards, clerk; Wm. S. Trethewey, mining captain, Theodore Dengler, mining engineer, and F. G. Coggin, Jr., mill superintendent.

The Atlantic includes the properties known as the South Pewabic and Adams mines before 1872. The South Pewabic made an especially dismal failure, which renders the success of the Atlantic the more striking. The Atlantic mine is located two miles south of Portage Lake and four miles southwest of Houghton. It has the Pacific on the north; the Isle Royale and undeveloped lands on the east; Isle Royale and undeveloped lands on the south, and Canal lands and the Pacific on the west. The mine tract comprises 640 acres, all on the mineral belt, being the south half of Section 4, except the southeast quarter of the southeast quarter; the north half of section 9, and the northwest quarter of the northwest quarter of Section 10, all in Town 54 North, Range 34 West. The company also owns all of Section 16, same town and range, bought in 1897, but which is undeveloped beyond a shallow exploring shaft from which a crosscut has been sent east and west for about 900 feet.

The production of refined copper has been as follows for the past four years.

Year.	Pounds.
1896	4,832,897
1897	5,109,663
1898	4,397,339
1899	4,675,882

For 1899 the income was $802,804.51, and expenditures amounted to $651,554.66, leaving net profits of $151,249.85. Of the money expended, $78,527.18 was for construction account, leaving $573,027.48 as the actual running expense of the property, this including mining, milling, smelting and marketing costs, and sundry expense of all kinds.

The dividends paid by this company were $780,000 to the end of 1899, and $860,000 to Oct. 1, 1900.

According to the sworn statement returned to the State of Michigan, under date Dec. 31, 1899, the financial condition of the company was as follows:

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Amount of cash paid in on capital stock	$280,000.00
Amount paid in by conveyance of property	659,642.11
Entire amount invested in real estate	716,591.77
Amount of personal estate	323,838.29
Amount of floating indebtedness	67,487.57
Amount due the corporation	7,596.04

A summary of some of the more important figures of the operations for 1899 is appended; these are taken from the admirable annual report issued to shareholders:

Tons of rock stamped	380,781
Pounds of mineral produced	6,147,555
Pounds of ingot copper made	4,675,882
Pounds of ingot copper per ton	12.28
Value copper from each ton	$2.10
Gross cost of copper per ton (including construction)	$1.71
Gross cost per pound of copper	13.9
Percentage ingot in rock	.614
Percentage ingot in mineral	.76

Receipts of the Atlantic company, from its organization in 1872 until the end of 1899, have amounted to $12,928,270.07, of which $700,000 was for the mines, $280,000 from assessments, $11,947,416.92 from sales of copper, and $853.15 from miscellaneous sources. The expenses of 1899 at the mine are summarized as follows:

Underground expenses	$299,219.98
Surface expenses	95,250.13
Railroad expenses	24,760.64
Stampmill expenses	88,917.59
Construction account at mine	54,981.04
Construction account at mill	18,384.75
Construction account—railroad work	5,251.39
Total expenditures at mine	$586,675.52

The total production of refined copper up to the end of 1899 has been 87,248,028 pounds.

The shafts of the mine are lettered in order from north to south, from "A" to "F," giving a total of 6 shafts.

"A," the northernmost shaft, was started late in 1897, to develop a newly purchased piece of ground. It is sunk at an angle of 54 degrees, or one degree flatter than the other shafts of the mine, and is the largest in dimensions of any of the six shafts, being 9 x 20 feet inside of timbers, with three compartments, two of which are skipways and one for men and pipes. The surface improvements at this shaft were completed in 1899, and consist of a fine shaft-rockhouse 35 x 67 on the ground and 84 feet high, of frame construction, fitted with four rock-

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crushers. There is a new boiler house, 38 x 50 feet in size, of redstone walls with steel truss roof, fitted with new boilers, also a new engine house 48 x 50 feet, of the same material as the boiler-house, containing a 26 x 48 double Corliss engine of Fraser & Chalmers manufacture. This is so built that it can be compounded later, when greater depth necessitates more economy in steam consumption. The hoisting is done over a double conical drum having a diameter of 10 feet at either end, and of 15 feet 6 inches in the center. Nine-ton skips are hoisted, in place of the three-ton loads raised by the 200 horse-power hoist originally set at "A" shaft. The shaft itself is 1,377 feet northeast of "B" shaft, and when first opened was quite rich in copper. This promise gave way, at little depth, to a long stretch of lean ground, which was decidedly discouraging, but there has been a marked improvement in the past few months, and the bottom drifts of "A" shaft are now in ground fully up to the average richness of the mine. This is important, as the shaft is more than a quarter mile north of the next shaft to the south, and commands a vast stretch of territory, the productivity of which will go far to assure a long life to the mine.

"B" shaft has two compartments, both being used for skip-tracks, there being no man-way. Underground the shaft is looking better than a year or two ago, while on surface it has been fitted with a magnificent new hoisting plant. The hoist is of Corliss pattern made by Fraser & Chalmers, with a double conical drum, the engine and drum being similar in design to the plant at "A" shaft, but much larger throughout. Installation was completed in the fall of 1900. The drum is 12 feet in diameter at each end and 24 feet 4 inches in diameter in the middle, where there is a cylindrical section 18 inches wide, the balance of the drum tapering sharply in both directions. The drum has a 22-foot face and in itself weighs 140 tons. All grooves are lathe-turned, for 1¼ inch steel cable. The hoist is operated in counterbalance and is good for a depth of 4,000 feet, or nearly twice the present maximum depth of the mine. Owing to its working in balance, eleven-ton skips are hoisted with ease, giving this shaft a wonderfully large productive capacity. The plant is speedy withal, being capable of hoisting at the rate of 3,400 feet per minute. It is built for operation at a steam pressure of 100 pounds to the inch, and is direct-acting and non-condensing. There are band brakes at either end, set by gravity and instantaneously released by steam power. This is one of the finest hoists in the district, and its completion in the summer of 1900 appropriately marks the advent of the Atlantic into the ranks of the Lake copper mines fitted with the gigantic machinery that has made the district famous the world over.

"C," next southwest, is the shaft that was burned in 1898. The timbering was destroyed and the shaft came together so badly that it was abandoned, the ground formerly reached by it being now accessible from "B" and "D" shafts.

"D" shaft, 1,465 feet southwest of "B," is the deepest and best

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shaft of the mine, being a trifle more than one-half mile in depth at present. It is 9 x 18 feet in size, inside of timbers, being of nearly as large size as "A" shaft, and has three compartments, two of which are for skips, worked in balance. It has a double conical hoist, with drum 12 feet in diameter at the ends and 21 feet in the centre, good for 3,000 feet. As the shaft is rapidly approaching the limit of the hoisting capacity of its machinery, a new engine house is being built and a new hoist will be installed early in 1901. The building is 48 x 60 feet in size, of redstone and with a steel truss roof. The new hoist is of Nordberg make, and in all essential features will be a duplicate of the powerful hoists installed within the past two years at various shafts of the Osceola, Kearsarge, Arcadian and Isle Royale. It will operate in balance and is calculated to hoist ten-ton skips from a depth of one mile. A new boiler house has recently been completed at this shaft, in which are installed two boilers of 150 horse-power each, with room for two more of the same size. The shaft is looking well in nearly all of the present stopes, and gives promise of good rock for the future. It commands a large territory, and with the new hoist in position will do the lion's share in keeping up Atlantic production for some years to come.

"E" shaft is used for a man-way and air and water pipes, no rock being hoisted therefrom.

"F" shaft is located 478 feet southwest of "D," and is 9 x 12 feet inside of timbers, with two compartments. The shaft is about 2,500 feet in depth and is served by a 24 x 48 inch engine having a 12 foot cylindrical hoisting drum. This shaft has shown disappointing ground for some time past, and stoping has been stopped in the southern drifts, as better rock is available elsewhere in sufficient quantity to feed the stamps, and the cost of tramming is hardly warranted by the meagre returns secured from the ground broken.

The Atlantic mine is opened on an amygdaloid of brownish, mottled color, the lode averaging about 15 feet wide, with a strike of N. 50 degrees E., and a dip of 54 to 55 degrees to the northwest. The lode is known locally as the ashbed, from fancied resemblance to an ash heap. It greatly resembles the ashbed of the Arnold and adjacent mines, is apparently in line of the southwesterly continuation of the Keweenaw county ashbed, and is the most westerly of the copper-bearing beds being worked in Houghton County. It also carries the least copper of any lode now worked, and has been famous for years for its profits, wrung from rock yielding much less than 1 per cent ingot copper. The low percentage of copper carried by the lode is a decidedly adverse factor, but one which no longer proves alarming, for the mine, under its present management, has met and survived nearly every trouble that copper mines are liable to, these including lean rock, mine fires, costly equipment necessitated by deepening shafts, new mills rendered obligatory by the government removing all mills depositing sands in the Portage Lake channel, and the building of private railroads required for the traffic of the mine.

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To offset the low grade of the rock, there are certain marked advantages. The ashbed is the softest rock mined in the district; it requires less power in drilling, less dynamite in breaking, and less steam in stamping, than any other lode; the rock breaks well and everything is mined, from wall to wall. The best of the lode is so low in copper that no assorting is attempted. The mine has an able and economical management, one which plans far into the future, and has been able to meet and surmount every difficulty so far encountered. Perhaps the greatest achievement was in building the new mill at Redridge, in 1894–95. The construction of a new mill was mandatory —it was either that or shut up shop, as the federal government peremptorily ordered the suspension of stamping at the old mill. The Redridge mill called for the expenditure of about $300,000 for the mill itself and its equipment, during the period of the lowest price ever known for copper; the construction of 9 miles of railroad; a big dam, and other expensive work. The funds were found, the mine continued working, and earned a mining profit on even nine-cent copper, and is again paying dividends. It has a new and modern mill, and within the past two years has made extensive betterments at the mine itself, in the way of new buildings and heavy machinery. The Atlantic is often quoted by mining men and the technical press as the finest example of a successful low-grade mine to be found anywhere, and deserves all the kind things said of it. It is certainly an inspiriting example. At a property which normally would be worthless, or worse than worthless, seven hundred men are steadily employed at good wages—for the Atlantic is by no means at the bottom of the scale as a wage-payer in this district, even though mining the lowest grade rock—and while steadily improving the mine and its facilities for economical production, handsome dividends have been, and are now being, returned to shareholders. The mining location is one of the neatest imaginable. There are about 250 dwellings owned by the company, and nearly as many more owned by employees. There are several churches, and a graded school which ranks among the best in Michigan. The Atlantic affords an example of thrift and success which can be studied to advantage.

Among the miscellaneous buildings are the compressor houses, "drys," carpenter, blacksmith and machine shops, and a sawmill, at the mine. There is a fire department, with apparatus and complete volunteer department, also fire pumps in the principal buildings.

The Atlantic Railroad, owned by the company, runs 3 miles from the mine to the old millsite, two miles west of Houghton, where the old wooden mill structure still stands. At this point there is a large coal wharf, coal being taken from the trestles on the wharf to the railroad cars by an incline tram. There is also a good merchandise wharf, the supplies for the mine being received at this point. The railroad equipment consists of five locomotives, four of which are Baldwins and one of Brooks manufacture, also 130 hopper-cars for rock

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and about 60 flat-cars for wood and miscellaneous freight. The main line of the railroad, from the mine to the new mill at Redridge, at the mouth of the Salmon Trout River, Lake Superior, is nine mile long, with favorable grades throughout.

The mill is 151 x 234 feet in size, of wood, on stone foundations. Water is furnished from a dam across the mouth of the river. The old dam, completed in 1894, is being submerged 20 feet by the new dam, a description of which will be found in the article on the Baltic. There is about two miles of lake frontage, affording sand-room for all time to come. The mill went into commission in 1895, and has six stamps, two of which are now running on Baltic rock, and four on Atlantic rock. The stamps have 18-inch cylinders, and when first installed crushed about 300 tons daily. Solid foundations were placed under the heads in 1898–9 and condensers were added early in 1900, these improvements increasing the capacity of each stamp by about 50 tons daily, without any marked increase in running cost. Power for the mill is supplied by a 14 x 42-inch Reynolds engine of Corliss pattern. There is a 7 x 14 x 12-inch Gardner fire pump in the mill, also a similar pump in the boiler house adjoining, for protection against fire. A machine shop is fitted up in the mill, and supplied with all tools required for repair work and fitting at that point. Experiments have been made during 1900 with Wilfley tables on the fine sands and slimes, with encouraging results.

Adjoining the mill is the boiler house, also of wood, on stone walls, 71 x 101 feet in size. A Green Fuel Economizer was added in 1899, and has worked successfully, saving about 12 per cent in fuel bills.

At the millsite there is a good frame warehouse, 30 x 36 feet in size, store building, smithy, and a number of comfortable dwellings for employees.

It has been rumored that a smelter would be built for the Atlantic and allied mines under this management. It is too early for the officials of the company to discuss the matter, but it would not be surprising if a smelter were built within the next two or three years. The tendency of the growing mines is to do everything for themselves that they can do, and the Atlantic, Baltic, and Wolverine, to say nothing of the Mohawk, Michigan and other mines of the so-called "Stanton" group which will soon become producers, could furnish mineral to run a good-sized smelting plant to its capacity.

The Atlantic company owns a square mile just north of the Baltic, and one mile south of the Atlantic mine. A shaft was sunk to the depth of 80 feet on this tract, in 1898, and a crosscut sent southeast across the formation, for a distance of about 800 feet in that and the following year. It was hoped to strike the Baltic lode, but the quest was unsuccessful, unless it be that a wide but barren amygdaloid cut just south of the shaft was the lode sought. The ill success is differently construed by different people, the various theories being that the lode was actually cut, but at a barren point; that there is a great faulting

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of the formation between the northernmost shaft of the Baltic and the crosscut, throwing the lode far out of its indicated position; and that the Baltic lode ends or is cut out south of the crosscut. Each of these theories is possible, but the truth will be shown within two or three years by the work at the northern end of the Baltic.

An amygdaloid lode, which bears some resemblance to the Kearsarge has been found outcropping on Section 9, some distance east of the ashbed. The southerly continuation of the Pewabic lode, on which it was first supposed the Atlantic mine was opened, should be found somewhere on the main tract of the Atlantic. In October, 1900, trenching across the formation was begun, near "B" shaft. The Atlantic must carry a number of cupriferous lodes in addition to the ashbed, several of which are liable to prove profitable. With its present equipment the Atlantic could open a mine on any new lode outcropping on its lands at the minimum of expenditure.

There are about 25 miles of shafts and drifts opened in the Atlantic mine, and the property, taking everything into consideration, was never before in as good condition, or with such pleasing prospects for the future, as at the present time.

BALTIC.

The Baltic Mining Company was organized under the mining laws of Michigan, in December, 1897, with a capitalization of $2,500,000 divided into 100,000 shares of the par value of $25 each. The principal office is at 11 and 13 William street, New York City, and officers are as follows: President, John Stanton; secretary and treasurer, John R. Stanton; directors, John Stanton, Joseph E. Gay, John R. Stanton, Wm. C. Stuart, and Cameron Currie, of Michigan. Annual meetings are held on the first Monday of March. The number of shareholders of record on Dec. 31, 1899, was 513. Local officials of the company are F. McM. Stanton, agent; A. D. Edwards, clerk; Thos. Rowlands, mining captain; F. G. Goggin, Jr., mill superintendent; Theodore Dengler, mining engineer.

The mineral property of the Baltic consists of 800 acres, lying near the Eastern Sandstone, a portion of the tract—approximately 75 acres—being on the sandstone. The tract consists of all of Section 21 except the southeast quarter, and the west half of Section 20, in Town 54 North, Range 34 West. The Baltic is bounded on the north by the Wheal Kate and the Section 16 tract of the Atlantic; on the east by lands of St. Mary's Canal Mineral Land Company, mostly on the sandstone; on the south by Canal lands, a tract owned by Hussey, Howe & Co., and by the Trimountain, and on the west by the Trimountain. The Baltic is two and a half miles south of the Atlantic mine in almost a due line, and its northernmost shaft is not quite four miles southwest of No. 10, the southernmost shaft of the Huron mine of the Isle Royale company. To the southward the Trimountain and Champion mines are opening on the same lode as the Baltic is working.

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The following figures are from the sworn statement, of date Dec. 31, 1899, returned to the State of Michigan by the Baltic company:

Amount of cash paid in on capital stock...	$ 427,249.00
Amount paid in by conveyance of property..	1,000,000.00
Amount invested in real estate.....	1,001,001.00
Amount of personal estate.....	187,095.09
Amount of floating debt.	19,251.31
Amount due corporation.....	2,330.96

There have been three assessments levied on Baltic shareholders, the first two being for one dollar each, and the third and last call, payable Sept. 18, 1899, being for $3 per share, giving a total of a half million dollars for the opening and equipment of the mine. The last assessment was required mainly for the building and equipping of a large and costly modern mill at the mouth of the Salmon Trout River. Contrary to the usual impression, the repeated assessments have served to advance rather than depress the market price of Baltic stock. As the moneys raised by assessments have been expended judiciously, and have been so laid out as to greatly enhance the value and prospects of the property, it seems fair to assume that some investors in Lake copper shares are not bereft of understanding, but, on the contrary, are in nowise shy of an assessment where its necessity is so plainly evidenced as in the case of this mine.

The following items are taken from the last annual report of the Baltic company, which gives to the owners of its shares very complete information regarding the property:

Receipts and expenditures for the year ending Dec. 31, 1899.

From assessments 2 and 3.....	$330,554.00	
From sales of copper—621,336 lbs.....	105,240.58	
From Atlantic Mng. Co.—advanced for building railroad.....	2,655.82	
Total.....		338,450.40
Running expense at mine.....	$160,079.39	
Construction account.....	30,016.27	
Explorations.....	5,321.23	
Total expenditures at mine.....		195,416.89
Smelting, freight, marketing and general expense.....		13,900.11
Real estate bought.....		1,001.00
Total expenditures.....		210,318.00
Net available assets, Dec. 31, 1899.....	$240,594.78	

For the year 1899 shaft sinking cost, on contract, an average of $24.74 per foot, and drifting, on contract, cost $6.45 per foot. Total underground expenses were $92,663.81, of which amount $15,382.11 was

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charged to power drills, this sum including fuel and labor on surface, for compressors. Hoisting cost $23,137.33, and selecting and breaking the rock hoisted cost $4,228.62. Miscellaneous surface work cost $7,926.78, transporting rock to the mill cost $5,311.65 and stamp mill expenses were $14,164.40. While the figures are not given in the report, it is apparent that the charges per ton were 15 cents for transportation and 40 cents per ton for milling. The mine should be able to get a lower rate for transportation charges, when it becomes a heavy producer, and with its own mill running can stamp rock for about 25 cents per ton—very likely several cents cheaper.

The miscellaneous expense account for 1899 was $13,738.80, of which by far the greater part, amounting to $9,618.74, was for taxes. The expenditure for superintendence, clerical labor, stationery, postage, office supplies, traveling expense and sundries was very small, amounting to but $3,147.06. The item of $5,321.23 for exploratory work was for continuing the Section 16 crosscut from the Atlantic boundary line on Baltic territory.

During the year there were stamped 35,411 tons of rock, which yielded 789,763 pounds of mineral, equivalent to 1.11 per cent, which in turn yielded 76.4 per cent ingot copper, giving an average return of 17 pounds, or .85 per cent refined copper.

The first work on the Baltic, which was known as the "Six Mile Hill" exploration previous to being dignified with a permanent name, was performed by the late Captain John Ryan, in 1882. He sank two shallow pits, the deepest less than 90 feet, and put down several diamond drill holes. Later developments at the mine show that he pitched his drill holes at an angle of about 55 degrees with the horizon, thus causing the drill to leave the lode and enter the hanging wall at less than 100 feet depth. Had Capt. Ryan pitched his drill 10 degrees sharper, the Baltic, under some other name, would now be one of the great mines of the district, or perhaps a thoroughly discredited property, through mistakes in management similar to those that have ruined other good properties in the past. The lands were owned by St. Mary's Canal Mineral Land Company, and were optioned in 1892 to an English promoter, one Maj. Ritchie, for three years. A two-year renewal was granted, and Maj. Ritchie got his clients to the point of depositing sixty thousand pounds in the Bank of England, pending a search of titles, but at this point the silver scare of 1896 caused the men of means to hastily withdraw their funds and call the deal off. Maj. Ritchie pleaded hard for another extension, but as there were others looking for the lands, this was denied. Capt. W. A. Dunn, of Houghton, took the property under option early in 1897, and within a few months had openings showing sufficient copper to warrant the formation of the Baltic company, which took over the property in December of the same year. The Baltic company has worked steadily and effectively for three years, and now has a mine second to none in promise of large and profitable production within the near future.

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As the Baltic lode outcrops, it underlies something less than half of the company's tract of 800 acres, but the dip is so sharp that each acre of surface will carry fully twice as much underlay as the average carried by the mines of the district The dip is the sharpest of any mine ever opened on any amygdaloid or conglomerate lode in the Lake copper district, the shafts being pitched at an angle of 72 degrees 73 minutes. It is possible that this angle is too sharp, but the lode rolls so in both its strike and dip, especially the latter, that the permanent angle cannot be determined until the shafts are at least twice their present depth.

The lode is nearer the Eastern Sandstone than any other now being worked in the district. Efforts have been made to identify the Baltic with the Isle Royale epidote, but the characteristics of the two are so dissimilar as to render this hypothesis untenable. It has been suggested that the "Mabbs' Vein" on the Isle Royale is a northerly continuation of the Baltic, but Dr. L. L. Hubbard, late state geologist, holds to the theory that the Mabbs is a fissure vein—although its strike and dip are apparently parallel with the formation. The Mabbs is narrow, and the Baltic wide, but there is a marked narrowing in the Baltic at the northernmost shaft, where it runs but 20 feet in width, as against 40 at many places to the southward, and about 55 feet (in cross-section) at one point in the second level of No. 2 shaft of the Baltic mine. The strike of the lode is N. 63 degrees E., along the line from shafts 2 to 4, but Shaft No. 5 is about 20 feet east of a line produced from the four shafts to the southward, giving the unprecedented strike of N. 65 degrees E., between shafts 4 and 5. It is manifest that this strike cannot be continued for any great distance, as it would bring the Baltic one and a half miles into the underlying sandstone in a distance of about six miles. In this connection the exploratory crosscut on Section 16, referred to in the preceding article on Atlantic, is of great interest. This crosscut was sent 160 feet west, from the bottom of a 52-foot shaft, and thereafter, the lode not being found to the west, a crosscut was driven, at right angles to the strike of the Baltic lode produced, for about 850 feet to the south of east. An amygdaloid about 40 feet wide was cut some 50 feet east of the shaft, but as it was barren, except for a little copper in the foot, and as it also lacked the bed known as the Baltic conglomerate, which underlies the amygdaloid at an average depth of 115 feet, wherever located near the Baltic shafts, the barren amygdaloid was held not to be the Baltic. A peculiar feature of the crosscut, which is only about 3,000 feet northeast of No. 5 shaft of the mine, is that the strike of the formation at that point is N. 48 degrees E. This gives a change of strike of 17 degrees in a trifle over half a mile.

The mystery of the whereabouts—or lack of whereabouts—of the northern end of the Baltic lode has attracted more attention from mining men and geologists than almost any other development of the past few years in the district. In addition to the theories of bending

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and faulting, there are two other contingences, one of which has received little attention, and the other none at all. The first of these is that the Baltic is cut out entirely between the shaft and crosscut; and the second—which I hesitate to mention in face of the danger that I may be flayed by some able geologist with a trenchant pen—is, that the upper measures of the Baltic have been eroded to considerable depth in ages past. The commonly accepted theory of the formation of the Keweenawan beds is that they are old lava flows (the traps), interspersed with layers of metamorphosed trap (the amygdaloids), and with ancient seabeds composed of detrital matter gained by the waves from adjacent benches of rock (the conglomerates). If this theory be correct, it is apparent that inequalities in the surface over which such flows were spread would lead to inequalities in the strata formed by the lava-flows themselves. This accounts very nicely for the marked irregularities in all amygdaloid beds, both as to strike and as to dip. The irregular regularity of the amygdaloids was perhaps best described by a Cornish miner of early days—Capt. Dick Nettle was his name, if I remember correctly—who answered, in response to a question as to whether the copper-bearing beds were straight or crooked: "They're so crooked as the creep of a worm, and so straight as a string." This paradox is almost literally true. Measured by hundreds of feet, the amygdaloids are decidedly crooked, both along their outcrop on surface, and in their descent into the bowels of the earth, but measured by thousands of feet, they are remarkably straight, barring the occasional faults and bendings, to which all strata are subject. Like a snake, they follow a straight path by many sinuous windings.

Given the deposition of the traps and amygdaloids by ancient lava-flows, it follows that as gentle irregularities in the surface would lead to similar thinnings and thickenings of the viscous lava spread over them, so a marked irregularity, like a large hollow, would lead to a pronounced thickening of the bed so deposited. Where there are valleys, there must be hills, and a gentle elevation would thin the lava stratum spread over it, while a big hill would cut it out entirely—for just so much area as the hill covered. A great hill or a small mountain would cut out the flow for miles. Furthermore, all lava flows must have an end, and while neither end nor bottom of any amygdaloid has yet been assuredly reached in this district, all such beds must come to an end, both on their strike and their dip, at some point.

As to the second contingency, mentioned with fear and trembling by a lay geologist: Is it not possible that the Baltic may have been eroded, in ages past, between No. 5 Baltic shaft and the Section 16 crosscut, to such depth that its outcrop—if such a term is permissible—would be found under the Eastern Sandstone? Marks of erosion are very plainly discernible from one end of the Keweenaw formation to the other, and as the underlying sandstone is unconformable, it is by

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no means impossible that the upper portion of the northern continuation of the Baltic lode may have been sheared off on the bias by some great erosive force. The marked divergence in the strike of the formation at No. 5 Baltic and at the Section 16 crosscut lends considerable color to the theory of a great fault between those points, but the other three contingencies named—bending, ending of the bed, and surface erosion—are all possible. The problem is an interesting one, and its solution will probably come in time. Dame Nature has strange secrets locked in her stony bosom, but man's curiosity and man's pertinacity will conquer many now unsolved, as they have conquered others in the past.

The easterly strike of the strata gives the Baltic company an unusually long outcrop on the lode, amounting to about 1⅘ miles on the Baltic lands. The average width of the lode, so far as opened, will probably run about 30 feet, in cross-section, and a few feet more, as commonly measured, on the plane of the levels as opened horizontally.

The Baltic shafts are numbered from south to north, with the exception of No. 2, which is south of No. 1, the discovery shaft. No. 2, the southernmost shaft, is nearly one half mile from the southwestern boundary of the Baltic lands, following the Baltic lode's strike produced. No. 1 is 535 feet northeast of No. 2; No. 3 is 635 feet northeast of No. 2: No. 4 is 900 feet northeast of No. 3; No. 5 is 855 feet northeast of No. 4. This gives a stretch of 3,025 feet between the extreme shafts, in addition to which several hundred feet have been proven by the north drifts from No. 5. While the northern end of the Baltic lode is a mystery, the southern extension is not, as it is being opened by both the Trimountain and Champion mines, south and west of the Baltic, with most flattering prospects. The Baltic may fail to find a profitable lode in a portion of the 3,000 feet northeast of No. 5 shaft on Baltic lands, but is reasonably certain to find the lode strong and rich in the half mile untouched between No. 2 and the Trimountain line.

At this writing, Oct. 24, 1900, No. 1 shaft is down to the third level, and Nos. 3, 4 and 5 are each to the fourth level, all levels being one hundred feet apart. Drifting is in progress on every level of the mine, and while slow progress is being made in sinking, the drifting is unusually well advanced, and is going forward on practically every level of every shaft, with stoping under way at a number of points. No. 3, having the best surface equipment, is furnishing the bulk of the production, but fine stopes are opened in the other shafts as well. The mouth of No. 2 shaft, on the high ground to the southwest, is about 120 feet higher than the collar of No. 5 shaft. The topography at the Baltic is what an optimist would call "diversified," and it would be wise not to actually call it hilly until after visiting the Trimountain and Champion, lying next south and west. Owing to this difference in the lay of the land, shafts 3, 4 and 5 have no first levels, the level opened nearest surface being called the second, as it is on the same plane as the second level of the southern shafts. Insufferable confusion would

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be caused were the levels at each shaft of a mine to be laid out at certain depths from the surface, rather than on some fixed base-line, usually, but not necessarily, the mean water datum of Lake Superior.

Old No. 1, the discovery shaft, is so crooked that it was deemed wiser to sink a new shaft near by, rather than to attempt cutting down and straightening the old one, which has been sunk to a depth of 220 feet only.

Shafts 4 and 5, the northernmost, did not show as much copper as the southern shafts, near surface, but are improving with depth.

The shafts were all opened with temporary equipments, which are being replaced, as opportunity offers, with permanent buildings and heavy machinery. No. 3 was the first to be given a permanent plant, and in consequence has become the principal shaft of the mine. At this point there is a substantial shaft-rockhouse, of wood, sheathed with steel, 35 x 71 feet on the ground and 88 feet high, with a wing 31 x 37 feet in size. It is fitted with two Blake crushers having 18 x 24 inch jaw openings, driven by an engine with 16 x 18 inch cylinders. It has rock-bins with 1,400 tons capacity, and a railroad track running underneath. A new engine house, 40 x 60, has been built; also a structure for boilers and compressor. Stirling water-tube boilers are replacing the horizontals used in the temporary plants. A fine new compressor has been installed, this being of the Riedler pattern—the first in the district—made by Fraser & Chalmers. It can supply air for forty power drills of large size, and running at 65 strokes, is guaranteed to compress 4,000 cubic feet of free air per minute to a pressure of 65 pounds to the inch.

No. 4 has a temporary plant, with a hoist good for about 1,000 feet, raising a one-ton skip. A small double hoist is used at No. 5, but will soon be replaced with something better calculated for deep work and heavy lifting.

In addition to the new compressor, there are three others, of fourteen, seven and four-drill capacity.

There are the usual mine structures, such as carpenter, machine and blacksmith shops, etc., part of temporary and part of permanent design, also two large boarding houses, and about 50 dwellings. The Baltic is now employing about 400 men, and must build additional houses next season.

The distance to the millsite, by rail, is very nearly 12 miles, with good grades for most of the distance. The Baltic has been paying 15 cents per ton for transportation of rock from the mine to the mill. The Atlantic has been stamping the Baltic's rock since July, 1899, when one head was started, the second head at the Atlantic mill being started on Baltic rock just one year later, in July, 1900. A new mill is being built for the Baltic, on the western side of the Salmon Trout river, at its mouth on Lake Superior, one half mile distant from and opposite the Atlantic mill. The foundation was completed in October, 1900, and required the excavation of about 30,000 cubic yards of earth

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and stone, and the laying of 400 cords of stone in the foundations. The superstructure, of steel throughout, requires fully 1,000 tons of material. The building is 175 x 195 feet in size, and should be ready for work in the spring of 1901. It was intended to have finished it this year, but the delays in delivery of material have kept back the completion of this, as well as of all other new mills in the district. The foundation and structure alone will cost about $90,000. The mill has room for four stamps, but will start production with two. These will be of Nordberg make, similar to those at the Osceola, Arcadian and Isle Royale mills, with 20 x 24 inch cylinders, rated as good for 500 tons daily and capable of crushing nearly 550 tons per diem on sustained runs. With them goes a compound condensing Corliss engine, capable of running the four stamps which will eventually be in place in the mill. Wilfley tables will be tried in place of finisher jigs and slime-tables. Foundation and floors are being laid for all four heads, so that the two additional stamps can be put in running order in the minimum time, when needed. The launder for waste sands will be 25 feet above the water level at the mill, allowing for the disposal of millions of tons of sand before a wheel or sand-pump will be required to aid gravity in handling the sludge.

Just at the rear of the mill a boiler house is being built, of similar material, 55 x 90 feet in size. At the rear of this a considerable area of level ground was secured by grading with waste from the mill excavation. This will be used for coal storage for both the Atlantic and Baltic mills, and will hold about 25,000 tons of bituminous coal. Several tunnels have been constructed beneath the floor of this storage yard, and tram-cars will take coal from the pile, in these tunnels, and run to the mills by gravity, ensuring unusually cheap handling of fuel.

One of the greatest feats of hydraulic engineering ever undertaken is at this writing nearing completion in the Atlantic-Baltic dam. The Salmon Trout River was dammed by the Atlantic six years ago, but the available water supply then secured, while ample for one mill, would be inadequate for two. The peculiar conditions prevailing at the mouth of the Salmon Trout rendered a dam of ordinary pattern almost out of the question, and a steel gravity dam was suggested by Mr. J. F. Jackson, of Houghton. At the request of the management of the Baltic, Mr, Jackson prepared plans, which were submitted to Foster Crowell, the well known hydraulic engineer, of New York. These plans were very carefully examined by Mr. Crowell, as no dam of the sort had ever been built, or even suggested. As the plans proved mathematically correct, and commercially feasible, they were approved by Mr. Crowell, who has acted as consulting engineer in the building of the dam, and has visited the work on several occasions. He designed the wings, on either side of the main structure, and also planned the valves, waste weir and and other parts of the work not pertaining strictly to the making of a water-tight structure calculated to impound the waters at its rear.

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The dam itself is 475 feet in length, flanked by wings, one of 350 feet at the east, and one of 200 feet on the west. The structure is known as a steel gravity dam, because the dam proper is of steel, though given some backing by concrete; and because it is held in place by its own weight of steel and concrete, gravity taking the place of anchorages. The strains were very carefully worked out by Mr. Jackson, and all figures verified with equal care by Mr. Crowell. The steel is furnished by the Wisconsin Bridge & Iron Company, and the concrete work has been done by Prendergast & Clarkson. The job is a stupendous one, requiring about 8,000 cubic yards of concrete and 1,000,000 pounds of steel.

The dam proper is in five sections, with a total length of 475 feet. Its greatest height above bed rock is 74 feet, in the central section and the new dam, built just below the old earthen dam, will submerge the latter to a depth of 20 feet, impounding an additional 600,000,000 gallons of water, giving a total capacity of about 1,250,000,000 gallons, equal to all possible requirements of both the Atlantic and Baltic mills, in even the dryest seasons. Work on the dam was rushed by both day and night crews during the season suitable for building, but it has been found impossible to complete the work before snow, and it will be finished next spring. In this connection, no small credit is due Mr. F. G. Coggin, Jr., who has not only had the management of a large stamp-mill, treating rock for two mines, but has also performed considerable in the way of changes at the old mill; has supervised the erection of the new Baltic mill, and has acted as supervising engineer at the building of the new dam—enough work to keep several men fully occupied.

As the Atlantic-Baltic dam is the first of its kind ever built, a brief description will be of general interest. The main structure, or dam proper, is 475 feet long, 74 feet high in the central, or deepest section, and has five sections. The wings on either side are in comparatively shallow water, and are made with cement cores, buttressed by earth embankments, the concrete cores being built up from the bed rock, excavated for the purpose,

The five sections of the dam proper are all of the same general design, the difference being that the central section is higher, as it is bottomed in the bed of the river, with a wider and heavier concrete base, and contains stronger steel bracing. Briefly described, the dam itself is of steel throughout, anchored into a base of concrete, and with braces between the crest of the dam and the extreme foot of the cement base. A description of the central part will suffice for the five sections. The concrete base is 62 feet wide, built up from rock excavation. The resultant of all pressures gives a pressure of 2,626,000 pounds for each steel section of 8 feet wide by 74 feet high. The upper 50 feet of the dam in this central section of 100 feet, is inclined at an angle of 45 degrees from the water, which throws the point of overturning within the central third of the concrete base, allowing an

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ample margin of safety. The dam proper is made of plates of the best boiler steel, concave on the water side, 8 x 16 feet in size, by ⅝ inch thick, riveted and caulked watertight, and supported by parallel inclined I beams 24 inches deep, for the full depth of 50 feet below the crest of the dam. In the lower section the steel is of ⅜ inch thickness, 8 x 16 feet in size, concave, riveted and caulked, but resting directly against the concrete base. The I beams of the upper or main section are supported by heavy triangular frameworks of inclined steel columns and struts. The whole steel structure is anchored to a 2-inch steel baseplate at the bottom of the concrete by a large number of 1¼, 2 and 2½-inch steel rods, 15 to 30 feet in length.

Water will be taken from the dam by 38-inch riveted steel pipes, from points about 20 feet below the crest, one of these being on the Atlantic and two on the Baltic side. A system of valves and waste weirs has been carefully devised, but the structure is of such a nature that it could not possibly be injured, even were water to flow continuously over its crest for an indefinite length of time.

Surmounting this dam, and in it, but not of it, is a railroad trestle, which was designed and built at the same time, but is in nowise a portion of the dam. The center of the railroad track is 10 feet downstream from the crest of the dam, and the track is 7 feet higher than the dam's crest. In the central sections the foundations for the feet of the trestle are all in the concrete work, but at the ends, the downhill or northern piers for the trestle are below the concrete work, and are separately built. This trestle will be used by the Copper Range Railway in reaching the Baltic, Trimountain, Champion and possibly other mills west of the Salmon Trout river.

The Baltic pays half the cost—$57,500—of this dam, and secures perpetual rights to one-half the water impounded by it, thereby saving pumping charges for all futurity, at the cost of the single initial outlay of a large sum of money.

The Baltic has passed the experimental stage, and has taken its place among the profitable mines of the district. Its ultimate position as a dividend-payer can be determined only by time, but that it is of the profit-earning class is no longer open to doubt. The product comes mainly in the form of stamp-rock, but with frequent small masses ranging up to a ton in weight, and a fair amount of barrel work. The masses are found mainly near the foot-wall, and the barrel copper on both foot and hanging, and not infrequently in the central portions of the lode. But a small amount of the rock hoisted is discarded—probably less than 15 per cent. The walls are very solid, requiring the minimum amount of timbering, which saves one heavy expense to which some mines are subject. At present there are about two miles of openings underground, which are equivalent to four or five miles in an average mine, owing to the great width of lode possessed by the Baltic. Other cupriferous lodes unquestionably traverse the Baltic territory, but it would be questionably policy to look for them, or to

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attempt to develope them, unless something of exceptional promise should turn up, until after the mine has begun to return profits regularly to shareholders.

For the year 1900 the monthly products of the mine have been as follows, the figures being for mineral, and not refined copper:

Month	Tons.
January	71½
February	56½
March	67
April	62
May	63½
June	61½
July	114
August	114
September	128
October	128
November	131

Figuring the mineral at 76.4 per cent, which was the average for 1899, the Baltic made 96 tons of copper in September, and the same amount in October. The value of this product, at the present market price of 16¾ cents per pound, would be $32,160 for each month, or at the rate of $385,920 per annum. The total expenses of the company for 1899 amounted to $210,318.00, or deducting construction account and real estate purchased, the expenditures were $179,300.73. The construction account was exclusively for new buildings and equipment on surface, all underground work being charged direct to operating expenses. The cost of running the mine for 1900 will be much greater, however, than last year. A considerably larger force is employed, and now that the mine is producing heavily, the costs of fuel and incidentals are also increased. If the percentage of the rock be the same this year as last—and no changes have been made in freight and milling costs—there will be a fixed charge of upwards of 3 cents per pound on all ingot produced, for rail-haul and milling. Taking everything into consideration, it is probable that the Baltic actually netted considerable profits during September and October. When the Baltic gets into its own mill, conditions will be much more favorable. There will be an immediate reduction of about one cent per pound in milling charges alone, and the increased production which the mine will then be able to make will spread certain fixed charges over a much greater production, thus reducing the cost per pound of making copper.

While the new Baltic mill will have but two stamps, they will be of the very latest and most powerful design, and should immediately increase the milling capacity not less than 75 per cent. Given rock averaging the same in copper as for the past two months, and the Baltic can turn out a trifle more than 200 tons of mineral monthly, equivalent to 150 tons of ingot copper, worth $50,000. Even better

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than this can be done when the mine is able to furnish the stamps to their full capacity of at least 1,000 tons daily, with rock averaging $^{85}/_{100}$ of 1 per cent ingot, which was the average for 1899. At this rate of production the Baltic would turn out 225 tons of ingot copper monthly, worth $75,000, at present prices. Whether the Baltic will be able to furnish the two stamps with a full supply of carefully selected rock by the time the mill is ready next spring is a question, but at any rate it can materially increase its present product, and with better hoisting and breaking equipment at the mine can soon feed the mill fully.

In this connection it may be stated that the Wolverine averaged only 16 pounds of copper to the ton in its first year of management by the same people as are at the head of the Baltic, but now makes 50 per cent better returns. With the mine more extensively opened, the Baltic can also make a better showing than 17 pounds of ingot to the ton.

TRIMOUNTAIN.

The Trimountain Mining Company was organized in February, 1899, under the Michigan mining laws, with capitalization of $2,500,000, divided into 100,000 shares of the par value of $25 each. All stock is issued. The subscription price of the shares was $12, and from the proceeds of $1,200,000 secured from the organization of the company, $800,000 was paid to St. Mary's Canal Mineral Land Company, for a tract of 1,120 acres of land lying west and south of the Baltic, and $400,000 was placed in the treasury for development purposes. The number of shareholders of record on Dec. 31, 1899, was 780.

Officers of the company are as follows; President, H. F. Fay; secretary and treasurer, W. B. Mosman; directors, H. F. Fay, Wm. Howell Reed, Edmund S. Clark, John C. Watson, Stephen R. Dow, W. B. Mosman and Jas. Chynoweth, of Michigan. The office of the company is at 60 State street, Boston, Mass.

At the mine, Captain Jas. Chynoweth is superintendent; Wm. J. Uren, assistant superintendent, and Thomas Carlyon, mining captain.

The lands of the company consist of a recently acquired mill-site on Lake Superior, reference to which will be found later, and 1,120 acres of land on the mineral belt, in a virgin district, west and south of the Baltic. These latter lands consist of the east half of Section 19; the west half of Section 20; the north half of Section 29, and the northeast quarter of Section 30, in Town 54 North, Range 34 West. The Champion mine lies immediately southwest of the Trimountain.

The treasurer's report for the year ending Dec. 31, 1899, showed expenditures of $101,565.84, and a balance of $305,005.19, of which $293,113,58 was in cash and $11,891.61 in supplies on hand at the mine. Receipts for the year were $6,571.03, from interest on Boston deposits.

Although the company was organized in February, the history of

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the mine begins two months later, deep snows remaining from a winter of almost unprecedented severity having rendered an earlier start impracticable. The first work of the Trimountain was done with the openings on the Baltic to the northeast and the discoveries on the Copper Range lands to the southwest as guides, but a considerable amount of trenching, test-pitting and diamond drilling was required to locate the lode. The Trimountain has an exceptionally heavy overburden of sand, resting like a blanket over the rock ledge, and that the lode was so speedily located was due to good fortune waiting upon well-directed effort. Work on the first permanent shaft, now known as No. 1, was begun in June, 1899. A few weeks later the Trimountain was in a fine, wide lode, rich in copper. Additional openings have shown a continuance of the same high-grade stamp-rock, with no inconsiderable amount of mass and barrel copper. At no mine ever opened in the district have the underground openings been more persistently promising than at this property.

No little trouble was had in locating No. 2 shaft. A drop shaft was finally sunk in mid-winter, and bottomed in the solid ledge, at a a depth of 106 feet, in February, 1900. From this sand shaft a crosscut was run 176 feet, when the lode was cut, and found to be 36 feet wide, measured on the floor of the crosscut. The sinking of this drop shaft greatly interested all practical miners, and is perhaps the finest example of work of this kind yet afforded. The overburden at this point was of sand, and of altogether exceptional thickness. Sinking a shaft through sand is the next thing to sinking a shaft through water. The sand, which is usually wet, and in this case was exceptionally so, oozes up into the bottom almost as rapidly as it can be removed. There are many instances where shafts of a similar nature, but of lesser depths, have taken months and required fortunes to sink, while many such attempts have been abandoned. The Trimountain drop was sunk in five weeks, making the time much the shortest, and the cost much the smallest ever secured at a shaft of this sort. The shaft was framed with exceptional strength, of 14-inch square timbers mortised and tenoned, and sided with heavy plank. The sods were cut away, and the first section of the shaft pressed down into the yielding sand, by weights laid above. A second section was quickly added to the top, and miners and pumps set at work removing the sand and water from inside. As rapidly as the shaft went down, more sections were added, and the whole mass pressed down by enormous logs laid across the top. There were days when the sand and water gained, but dogged persistence won out, and the shaft was bottomed safely, in exactly 35 days—an average of three feet a day sunk through the kind of material that all miners fear the most. In the telling, the sinking of this drop shaft seems a very simple matter, but experienced miners know better.

The Baltic lode, where opened by the Trimountain, runs 16 to 40 feet wide, the minimum width named being found at only one point.

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An average of 25 feet can be safely given, this being exceptionally wide for a profitable lode in this district. It is not only wide, but strong in copper, and the copper is not found mainly along the walls, as in many mines, but at all points across the lode. The mass and barrel copper is principally near the walls, masses having been found weighing upwards of a ton, but the main reliance must be placed in the stamp rock, which is rich in shot copper—a form of rounded nodules giving good returns for the copper shown.

Lying about 75 feet west of the Baltic bed there is a parallel amygdaloid of even greater width. This has shown fine samples of stamprock from drill borings, but as opened by crosscuts is disappointing. It will be given more thorough exploration later, but at present the energies of the mine are confined to opening the Baltic lode for production in the near future.

At this writing, November 10, 1900, there are upwards of 1,200 feet of drifts opened in the mine, mainly from No. 1 shaft, and shafts 1 and 2 will soon be connected on the first level. The amount of opening work would have been greater but for the delays in locating permanent shafts north of No. 1 owing to the heavy overburden. With drifting going on in two shafts, both north and south, and with a third soon to begin opening levels, much more ground will be opened in 1901 than it has been possible to open in the preceding eighteen months.

The permanent shafts are all of the same size—8 x 22 feet outside of timbers—and are framed with exceptional solidity, of 14-inch sticks. This is advisable by reason of the pressure from the shifting sand lying above the ledge of rock. All shafts have three compartments, two for skips and one for ladders and pipes.

About 250 men are now working at the mine, and a considerable force will be employed during the winter at the millsite.

Shaft No. 1 is sunk about 210 feet northeast of the boundary line of the Champion mine, at an angle of 72 degrees, practically the same as at the Baltic. The strike of the formation on the Trimountain is more to the northward than at the Baltic, however. There is an overburden of nearly 40 feet of sand, on the dip of the shaft, and the first level is opened at a depth of 168 feet below the collar of the shaft. The surface at the Trimountain being very irregular, the first levels of the mine will vary greatly in depth, at the different shafts. Levels will be opened at distances of 100 feet below the first. No. 1 shaft has just reached the third level, at a depth of 368 feet, and will continue downward steadily. The south drift on the first level of this shaft has reached the Champion line, and the north level is in nearly 800 feet. Drifts have been started both north and south on the second level. All openings, at this, as well as at No. 2 shaft, are in good ground, and if the lode holds its present richness throughout its length and depth on Trimountain lands, it will be possible to stope pretty much everything between foot and hanging walls. The early

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opening in this shaft was done by a bucket working on skids, followed later by a trolley cable, and in September last by the installation of a 14 x 18 inch Fraser & Chalmers hoist, good for 1,500 feet, which is raising one-and-a-half ton skips on permanent tracks. The tracks are of full width, and sufficiently heavy for the six-ton skips which will be installed later. On surface there is a boiler house 48 x 52 feet in size, having three horizontal boilers of 125 horse power each; an engine house 24 x 24 feet, with an addition 16 x 24 feet, in which is located a 14 x 20 inch cylinder straight-line air compressor, of about ten-drill capacity. The rock-shafthouse stands 40 x 62 on a stone foundation 12 feet high, and is 84 feet in height above the masonry. It is fitted with steam hammer for mass copper, crushers and large rock-bins, and there is room under the pockets for two railroad tracks. Both shaft and shafthouse are planned for heavy production.

No. 2 shaft is down to the first level, and drifting will begin shortly. Owing to the shaft's elevation, the first level is 200 feet below surface. This shaft was sunk from surface and raised from the crosscut driven from the drop shaft simultaneously. It has been given a fine equipment, and the underground prospects are excellent. The hoist is a duplicate of the one at No. 1 shaft, and was completed only a few weeks ago. A new and powerful compressor has just gone into commission. It is a cross-compound Rand, similar to the one installed last winter at the Kearsarge shaft of the Centennial, and can furnish air for 35 drills. Just south of the compressor house is a Deane condensing plant, in a separate building; and to the north is the new boiler house, in which are placed two horizontal locomotive fire-box boilers of Burt make, of 200 horse power each, which furnish steam for the compressor and hoist.

No. 3 is a new shaft, started in the late summer of 1900, and has penetrated through quite a heavy overburden of sand, similar to that found at the other two shafts. It is of the same size and build, and is placed 1,100 feet northeast of No. 2, the lode having been located by drill borings. It is now down about 90 feet.

No. 4 shaft will probably be put down about a quarter mile northeast of No. 3, but the exact location remains to be decided. There is also room for a fifth shaft west of the Baltic line, unless No. 4 should be placed about 1,800 feet from No. 3.

Ten power drills are now in use at the mine, and this number will be greatly increased, as rapidly as room can be found for them. The shafts are now at a point where a considerable number of new drifts can be started within the next six months, and should open some magnificent stopes during the coming year.

The principal mine buildings are located in the neighborhood of No. 2 shaft. There is a machine shop 32 x 45 feet; carpenter shop 40 x 60 feet; smithy 25 x 45 feet, and a warehouse 30 x 60 feet with office in the front portion, the shops being well supplied with tools and power. There is also a portable sawmill with a capacity of about

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12,000 feet daily. This is a very valuable asset, its earning power being entirely disproportionate to cost or size of the plant. The Trimountain tract is densely timbered with pine and hardwood, mainly the latter, and the mill can go to the wood easier than the wood can be hauled to the mill. It is kept busy sawing lumber and plank for the mine and surface improvements, and has already paid for itself several times over, and will return proportionate dividends for many years to come.

A cistern for feed-water for the boilers has been constructed at No. 2 shaft, this being required to store an adequate water supply from a small brook running thereby. A house has been built over the cistern and a good fire-pump installed. Ample hose is also provided for the defense of the mine buildings. The need of this was shown by a bush fire only last month, which gave the mine and location a close call. As the forest will be pretty well cleared away from the principal buildings in another year, this danger will be greatly lessened.

There are about forty dwellings on the location, twelve new ones having been completed last month. There is a very large boarding house, capable of comfortably accommodating 75 men. The mine location is rapidly changing from a straggling collection of huts and houses set in the forest primeval to an orderly and bustling little mining camp. More houses will be demanded next season, in view of the increased force to be worked. There is a store, 40 x 40 feet in size, well stocked with goods, but this is already inadequate, and an addition of equal size will be built beside it this winter.

Permanent roads, well ballasted and with fair grades, have been built to all the shafts and principal buildings. This is highly important in view of the hilly nature of the mine's surface, and the heavy teaming required before the advent of the iron horse.

The Trimountain will be served by the Copper Range Railroad, which already crosses the northwestern edge of the mine's territory. An important agreement was recently entered into between the Trimountain company and this railroad, by which the mine was given an excellent millsite on Lake Superior in return for a traffic contract, by virtue of which the Copper Range will haul the Trimountain's rock to mill. The arrangement is mutually profitable, as it will give the railroad a large and steady traffic, something greatly needed by a new line developing a virgin territory, and provides the mine with an excellent millsite without cost. The millsite is located on the shore of Lake Superior, two miles west of the Salmon Trout and three miles northeast of the Graeverat river. There is a little stream entering the lake at that point, which by damming can be made to furnish feed water for the boilers of both the Trimountain and Champion mills, but it will be necessary to pump water required for milling purposes. The millsite was acquired in October, and men were immediately set at work cleaning away the brush and building camps. It is not probable that much more than clearing the site can be accomplished before

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spring, after which work can be rushed. Judging from the delays experienced in the receipt of material and machinery for the new mills built in this district in the past two years, the Trimountain will be very fortunate if its mill is in running order before July 1, 1902, though it is hoped to have the stamps pounding out copper by the end of 1901. The mill will be strictly modern in design, material and machinery, and although permanent plans are not yet drawn, will probably be on much the same scale as the Baltic's new mill, containing two heads, with room and foundations for two more, which can be added on short notice as required. The cost of such a mill and equipment will not fall below $150,000, and may easily reach $200,000 or more.

Taking into consideration the heavy expenditures at the mine this season, and the necessity of raising a large sum for the new mill, in addition to continuing development work and construction at the mine for at least another year, and very likely for 18 months, before the mill can begin producing, an assessment is inevitable in the near future. In view of the great amount of work done this year, it is doubtful if much more than a quarter of the original cash working fund of $400,000 will remain on hand by the close of the current year. Under these circumstances an assessment of $3 per share should not prove surprising, and an even larger sum may be called for. This, however, need not alarm shareholders. There is enough rich rock in sight in the Trimountain mine to warrant whatever expenditures may be required to give the property a permanent equipment of the best sort, built to produce large quantities of copper cheaply. Economy carried to the extent of giving the mine anything short of a first-class outfit of mining and milling machinery would be something else than true economy, at the present stage of the mine's history.

CHAMPION.

The Champion mine is owned by the Champion Copper Company, of which officers are as follows: Wm. A. Paine, president; Frederic Stanwood, secretary and treasurer; Wm. A. Paine, Frederic Stanwood, Frederick A. Hall, Chas. H. Paine, George E. Leonard, John H. Rice and Albert R. Gray, directors. The principal office of the company is at 27 State street, Boston, Mass. At the mine, Dr. L. L. Hubbard, late state geologist, is general manager, and John Broan mining captain.

The Champion Copper Company is a wheel within a wheel. It was organized in December, 1899, and its stock is owned in equal proportions by the Copper Range Company and St. Mary's Canal Mineral Land Company, each of which holds 50,000 shares, out of the total capitalization of 100,000 shares. The stock was marked $5 per share paid in at organization, and an assessessment of $1 per share levied when the company was formed placed $100,000 in the treasury for development. An assessment of 25 cents per share has since been paid.

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Judging from the work accomplished at the mine the company must have expended all of $125,000 underground and on surface in the eleven months that have elapsed since the company was formed.

The mineral lands of the Champion mine consist of the south half of Section 30; the west half, the north half of the northeast quarter, and the southeast quarter of the northeast quarter of Section 31, Town 54 North, Range 34 West; and the southeast quarter of Section 25, and the east half of Section 36, Town 54 North, Range 35 West, making a compact tract of 1,240 acres. Of this tract, the Copper Range Company furnished a rectangular block one mile wide and one and a half miles long, on the west, amounting to 960 acres, and St. Mary's Canal Mineral Land Company supplied 280 acres adjoining on the east. The Canal company got half the stock, though furnishing only 30 per cent of the land, because its realty was absolutely essential to the formation of the mine on correct lines. A very small portion of the Champion tract overlaps upon the Eastern Sandstone, leaving fully 1,200 acres on the mineral belt.

The neighbors of the Champion are the Copper Range and Trimountain on the north; Canal lands and lands of Hussey, Howe & Co. on the east; Hussey-Howe lands and the Globe property on the south, and the Copper Range tract on the west.

Work on the Champion was begun in the spring of 1899, on the northeast corner of Section 31, that being the nearest to the Trimountain of the lands owned by the Copper Range Company at that time. This work was begun under direction of Dr. Hubbard, who resigned the position of state geologist to take charge of the mineral explorations of the Copper Range Company. His work was crowned by such immediate and spectacular success that the old prejudice existing against "theoretical" miners has been wonderfully ameliorated in this district ever since he opened, on ninety days' notice, what is perhaps the richest showing of copper found in the Lake district since the discovery of the Calumet & Hecla in 1866. Three parallel amygdaloids were uncovered by trenching across the formation at right angles, and one of these, now identified as the southerly continuation of the Baltic, showed such phenomenal richness in copper that the first reports from the find were regarded with suspicion, and very naturally so, as all "record-breaking discoveries" do not pan out as such upon careful scrutiny. The Champion, however, has never belied its name from the first opening of the lode.

Ten test-pits were sunk on the lode at intervals of a few hundred feet, and all were bottomed in the same rich rock. The two parallel amygdaloids, one of which overlies the Baltic at a distance of only 60 feet, show copper in sufficient quantity to render their careful exploration assured at some future date, but the management is wisely letting them alone at present. No better showing could be asked than is found in the shafts of the Champion, and the only proper policy to follow is the one now in force, which calls for the bending of every

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energy toward the opening of a big mine, in order that the prospective dividends, visible to every shareholder in the copper-shot amygdaloid of the Baltic lode, may be realized at the earliest possible date.

The lode dips at about 70 degrees, practically the same dip as at the Baltic and Trimountain, but has a strike nearly the same as at the Trimountain, next north, rather than the exaggerated eastern strike found at the Baltic. The rock carries an appreciably larger quantity of epidote than further north, though not nearly so much as is found in the Isle Royale and Portage lodes at Portage Lake, this lending some color to the theory that the Baltic is possibly a southerly continuation of the Isle Royale amygdaloid bed. The surface at the Champion is very hilly, but the overburden is much less than is found one mile north at the Trimountain, permitting the location of the lode and the sinking of shafts to much better advantage. The lode, as opened, runs 18 to 45 feet in width, as measured on the floor of the levels.

The showing at the Champion is rather richer than at the Baltic or Trimountain, though both of those properties have rock of excellent quality, and every prospect of making large and profitable mines. The present showing at the Champion is only to be compared with the best openings of the Mohawk, Baltic and Trimountain, some stopes of the Isle Royale and the rich ground of the Wolverine and Quincy. If the present showing in the mine continues to depth, as it should, the Champion must inevitably become one of the very largest and most profitable mines of the district. No mining man who has ever examined the property has expressed any but the most positive opinion as to its fine prospects.

The mine is rich in both stamp rock and heavy copper. Masses have been found up to a ton in weight, and the small masses, generally known as barrel-work, are found in profusion. The showing in stamp copper is excellent. Of course the mine is not of equal richness in all parts, the ground opened in "D" shaft leading in apparent value, but so far the amount of really poor ground opened is surprisingly small, especially in view of amygdaloid lodes being notoriously bunchy. The miners are considerably hampered in drilling, from the amount of copper. A drillhole is not easily started in copper, and if a mass is found within an inch or so from the point where drilling is begun, a new hole is usually started. This trouble is one that the management takes very philosophically.

Until the Champion has actually proved its values through months of sustained milling, it is impossible to accurately forecast its percentage in ingot copper. There is certainly much ground in sight that will run two, three and even five per cent, but it is the general average that counts in making a mine profitable. All that can be said with certainty is, that the present showing is of altogether exceptional value, and the mine, given a continuance of the competent management it now enjoys, is certain to prove one of the largest and best in the district, when fully opened.

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A discovery of geological interest, as well as considerable commercial importance, was made in a cut between "B" and "C" shafts, in September, 1900, when a cross-vein of copper glance was struck, by the workmen grading for a railroad track. The vein was followed for a short distance, and will be given attention later. It was of 6 to 12 inches in width at surface, and was composed of a very pure grade of chalcocite, which is a sulphide of copper, and the richest ore of copper known, running nearly 80 per cent ingot, in weight, when chemically pure. Chalcocite is found at many points in the various copper districts of the world, but rarely in quantities of commercial importance outside of Butte, Montana. The very limited amount of work done on the vein is insufficient to afford any good basis for an opinion as to its probable value, but as a 6-inch vein of pure chalcocite carries about the same amount of copper as the average of the Calumet conglomerate for its full width, the little fissure will be carefully followed next spring, until an idea can be formed of its probable permanence, or lack of it. The fissure veins are notoriously unreliable, but a vein carrying values of upwards of $250 per ton is worth investigating, even though but a few inches wide.

All shafts are of three-compartment size, and of permanent design and timbering from surface down. Hoisting has been done with buckets on skidways first, and with trolleys later, but sleepers have been laid for skip-tracks in all shafts, as the timbering progressed, and a skip is now running in "E" shaft, and skips will soon be introduced in the others. There are four shafts, numbered from the northward. "B" is the northernmost, being about one-third mile southwest of the Trimountain line, to which a drift has been run from No. 1 shaft of the last-named property. "B" shaft is located at an elevation of 635 feet above mean water datum of Lake Superior, and is down to the third level, with drifting both north and south on each level, the drifts on the third level having been recently started. "C" shaft is next south, at a distance of 1,270 feet, and its collar is 616 feet above Lake Superior. Drifting is in progress both north and south on the first and second levels, with a plat cut for the third level. Next in order is "D" shaft, 1,050 feet south of "C" and 621 feet above the lake. This is the original, or discovery shaft, and is down to the third level, with drifts both north and south on the two levels above. "E" shaft, the southernmost, is nearly a quarter mile south of "D" and is the deepest in the mine, having reached the fourth level. It is located on the lowest ground of the four, and has no first level, but drifting is in progress on the second and third levels, and will soon be started on the fourth.

In addition to the four shafts named there is room for another shaft to the north, to be known as "A," and for one more to the south, to be called "F," giving a total of six shafts on the property, which will open the entire Champion tract. At the present writing, November, 1900, the mine has about three-quarters of a mile of openings, in

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shafts and drifts, and is so opened that new work can be carried on much more rapidly than in most mines of its inches. Drifts are going forward on every level of every shaft—a most unusual circumstance—and all are showing good milling rock, which is a circumstance even more unusual.

A contract was made in September for a new steel shafthouse and rockhouse at "D" shaft. Contracts were also made for the headframes for "B" and "C" shafts. These will be set up at once, allowing hoisting to advantage, and the rockhouse portions, also of steel, will be added in the spring or summer of 1901. The machinery equipment at the Champion has been of a rudimentary nature, but permanent plants and buildings are now being planned, and every effort will be made to have the mine so fitted as to be capable of furnishing rock for two stamps at the Atlantic mill as soon as the Baltic drops their use on the completion of its own mill. The Champion will be in condition to furnish the rock by that time, and the only question is, whether the machinery can be ready by that date. A producing mine calls for a complex equipment of boilers, hoists, compressors, rock crushers and shops, as well as the copper rock in the bowels of the earth.

About 150 men are now employed at the mine, and this number will probably be doubled, or perhaps trebled, when the mine becomes a producer, which will presumably be during 1901.

Surface improvements of a permanent nature at the Champion include a handsome new mine office, 36 x 48 feet in size, of wood, two and a half stories high, just completed; a two-story schoolhouse of wood; two boarding houses, and about 25 dwellings for employees. A large permanent building is now under construction for the big compressor ordered. The mine is located in a fine hardwood forest, and a number of the best trees are being spared, which will add much toward making the location a handsome and homelike one in the future. A number of employees have shown their faith in the future of the mine by building houses for themselves on lots leased from the company.

An extension of the Copper Range railroad is being built to the mine. This branches from the main line about a mile south of Atlantic, and will serve the Baltic and Trimountain mines also. The extension is eight miles in length, and was begun in July, 1900.

A site for the Champion's mill has been selected opposite that of the Trimountain, on Lake Superior, two miles west of the Atlantic and Baltic mills. Plans for the mill are under consideration, and the matter is one which must be taken up soon, probably in 1901.

COPPER RANGE COMPANY.

The Copper Range Company, organized early in 1899, is not a mining company, neither is it a railroad company, although it owns a railroad by proxy, and half a mine vicariously, and is the possessor

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of nearly ten thousand acres of land on the mineral belt. It was organized as a development and promotion company, and its mission in life is to build up a section of the copper district that has been much neglected in the past. It is engaged in a work of great importance to the copper country, and has already effected a vast change in local conditions, with every prospect of steadily growing as a factor in the development and business of the Michigan copper field.

The Copper Range Company has a capitalization of $2,500,000, divided into 100,000 shares of the par value of $25 each. It has a very broad charter, and is empowered to do a great many things—almost anything, in fact, that may be needful. Its officers are as follows: President, Wm. A. Paine; vice president, John H. Rice; secretary and treasurer, Frederic Stanwood; directors, W. A. Paine, J. H. Rice, Frederic Stanwood, F. A. Gilbert, J. H. Seager, R. R. Goodell, F. McM. Stanton, Cameron Currie and S. L. Smith.

The parent company is the owner of the Copper Range Railroad Company, and of one-half of the capital stock of the Champion Copper Company. Its property assets, other than stock in these corporations, consist of 8,720 acres of land, located in a compact tract in Towns 54 North, Range 34 West, and 54 North, Range 35 West. Of this landed estate, something over 5,000 acres is located on the mineral belt, the balance being on the Western Sandstone, though owing to lack of definite exploratory work in this district, especially on the western side of the belt, only an approximate line of demarcation can be drawn between the trap formation and the overlying sandstone. In addition to owning the lands noted, in fee simple, the company has a long-term option on an additional 2,000 acres of contiguous land owned by St. Mary's Canal Mineral Land Company, which can be drawn upon at will, in case mineral discoveries warrant the cutting out of other mines. The company also owns a millsite of 441 acres, at the mouth of the Graeverat river, Lake Superior, ten miles northwest of the Champion mine, and three miles southwest of the sites of the Trimountain and Champion stampmills.

The Copper Range Railroad Company, a subsidiary corporation, has built and equipped and is now running a railroad 41 miles in length, between Houghton and Mass City, Ontonagon county. This line traverses a virgin territory, and has made possible the reopening of a number of old mines, as well as rendering it feasible to develope new mines in the district lying between the Atlantic mine and the Ontonagon river. The road has suffered ill fortune, through failing to secure anticipated railroad connections, but is gradually increasing its volume of business, both local and through traffic, and is understood to be paying expenses. An arrangement has recently been concluded with the Trimountain Mining Company, by which the Copper Range company will obtain a large volume of business in return for a millsite given the Trimountain. The business of the Baltic will be another great aid, and the Champion will help to swell the traffic

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within the next two years. There are also a number of promising mines to the southwestward, from which considerable local business is already being obtained, and for which the Copper Range is prepared to transport rock when they arrive at the productive stage. Immigration has been stimulated by the building of the line, and lumbering and agriculture are following in the wake of the iron horse. The road traverses one of the finest stretches of hardwood land to be found in the northwest, and this timber will eventually become the basis of various manufacturing industries, on Portage Lake, and perhaps at other points. The line is doing a great deal to develop and diversify the resources of Houghton and Ontonagon counties, and will eventually be extended from Houghton, its present northern terminus, to Calumet, and perhaps beyond. R. T. McKeever is general manager of the road.

The Champion Copper Company, of which the Copper Range Company is a half owner, has been treated of in the preceding article.

The stock of the Copper Range Company was marked $20 per share paid, on the formation of the company. A fund of one million dollars was set aside for the building and equipment of the railroad, and $250,000 was devoted to mineral development. The railroad proved more costly than had been anticipated, and bonds to the extent of $800,000 were authorized, of which amount $630,000 remained unsold in the treasury at the date of the last meeting, in July, 1900. An assessment of $3 per share was called immediately after the annual meeting, payable August 6, 1900, to provide funds needed for the construction of a branch line to the Baltic, Trimountain and Champion mines; for the betterment of the main line and rebuilding of certain defective portions, and for the development of the Champion mine.

Dr. L. L. Hubbard is in charge of the mineral lands of the company, and they will be explored systematically. Not much work has been done on them during 1900, because of the various drains upon the Copper Range Company's resources, and the desirability of devoting immediate attention to the opening of a large mine on the Champion tract. It is probable that a systematic exploration of the Copper Range lands will be begun next spring, consisting of diamond drilling and trenching, under direction of Dr. Hubbard.

ELM RIVER.

The Elm River Copper Company was organized under the laws of New Jersey on April 20, 1899, with a capitalization of $2,500,000, divided into 100,000 shares of the par value of $25. The stock was marked $12 per share paid in, of which half was for the lands comprised in the holdings of the company, and the balance was placed in the treasury for exploratory and development work. Annual meetings of stockholders are held in April, and officers of the corporation are as follows: President, H. F. Fay; secretary and treasurer, W. B. Mosman; directors, H. F. Fay, W. B. Mosman, John C. Watson, Stephen R. Dow

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and Chas. N. King. The principal office of the company is at 60 State street, Boston. Jas. Chynoweth is superintendent, and Wm. J. Uren, assistant superintendent, is directly in charge of the work at the Elm River property.

The expenditures of the company for the first year were practically one-third of the cash capital. The various items of expense to the close of 1899 were as follows, according to the financial statement of the treasurer presented at the annual meeting held in April, 1900:

Organization expenses	$24,865.41
Construction account	47,094.16
Machinery and equipment	34,604.15
Labor and supplies	66,342.89
Store account	8,324.80
All other expenses	13,626.89
Total	$194,858.30

In addition to which there were accounts payable at the mine amounting to $19,177.11, against which, as an offset, there were supplies at the mine estimated to be worth $14,297.20.

The Elm River property comprises 2,360 acres of land, in Section 6, Town 52 North, Range 35 West, and in Sections 1, 2, 11 and 12, Town 52 North, Range 36 West. The tract was a virgin one when taken by the present owners, the nearest attempt at mining having been made on the Shawmut and Stonington properties more than forty years ago. The property is bounded on the north, east and south by undeveloped mineral lands, and on the west by the Shawmut and undeveloped lands. The Elm River is located in approximately the center of the Keweenawan trap formation, or copper belt. It lies about 22 miles southwest of Houghton, by wagon road, and at about the same distance by the Copper Range Railroad.

Work was started, in a virgin forest, in June, 1899. Operations that year were greatly handicapped by the necessity of hauling all supplies, including heavy machinery, for considerable distances over roads more than usually bad. Trenching was resorted to, and a series of pits put down on the outcrop of a likely amygdaloid. A large amount of diamond drill boring has been done, and the drill is still in use. Three amygdaloids carrying more or less copper have been found and opened to greater or less extent. The two lodes opened in 1899 are known as the Winona and Shawmut, being supposed to be continuations of the lodes opened in the mines of those names. The Elm River tract carries a length of about 2½ miles on the formation, on the axis of its length, giving a long outcrop as well as great depth on any mineralized lodes found in the eastern or central portions of the property.

Five pits were opened on the Winona lode in the summer of 1899, of which the two most promising were developed into permanent

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shafts, known as Nos. 1 and 2, located about 800 feet apart. The shafts were started at an angle of 68 degrees, which was too steep, shown by the shaft leaving the lode and entering the footwall at about 100 feet in depth, crosscuts being required to reach the lode at that depth. The shafts are of three-compartment size, and permanently timbered. The lode ranges from 12 to 30 feet wide and is erratic as to strike, dip and width, and is apparently considerably disorganized for some distance below the surface. There is also much variation as to quality, some excellent rock having been found at times, interspersed with long stretches of ground so poorly mineralized as to give no promise of yielding copper at a profit. The lode carries considerable epidote and is apparently showing a little better in the bottom of the shafts, 300 feet down, than nearer surface, though the improvement is not sufficient to give great encouragement. The shafts are furnished with small Fraser & Chalmer double hoists, good for about 500 feet in depth, that at No. 1 having 6x8 cylinders, and the one at No. 2 having 7 x 10 cylinders. At No. 1 there are two Burt boilers of 125 horse-power each, and at No. 2 one similar boiler. There is a 15-drill air compressor at No. 1, with pipe line running to No. 2.

Shafts 3 and 4 are opened on the so-called Shawmut amygdaloid, lying parallel with and about one-half mile west of the Winona lode. The shafts on the Shawmut are about 800 feet apart, and have been sunk to little depth. This lode runs 15 to 18 feet wide, and is fairly regular so far as opened. The rock is a dark-colored amygdaloid, notably rich in prehnite, calcite and quartz, with some epidote. It also carries copper, but not in promising amount, so far as explored.

In the summer of 1900 the drill revealed the existence of an amygdaloid lying about 1,000 feet east of the Winona bed, and near the eastern boundary of the Elm River lands. Trenching and test-pitting having given favorable indications, a permanent three-compartment shaft was started thereon in August and is now sinking. The shaft is located about a quarter mile east of No. 1, and is sunk at an angle of 55 degrees. It is at present about 200 feet in depth and carries heavy copper and stamp rock to a fair extent, though quite bunchy. A new shafthouse, 28 x 30 feet in size, is being built at this shaft, No. 5, and a pit, opened about 300 feet further north, is bottomed in the lode. It has been stated that this new lode might be the Baltic, but there is no marked similarity in appearance, and there is every reason to think that the Elm River's new lode is too far west to prove a continuation of the amygdaloid opened in the Baltic, Trimountain and Champion mines. It is, however, more promising than the other two amygdaloids previously opened, and carries considerable copper in the better reaches, the metal being found in small masses of several pounds weight, as well as in stamp-rock form. A considerable amount of additional opening work will be required before an adequate opinion of the value of the lode can be formed.

Work on the Winona and Shawmut lodes was stopped in October,

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1900, and effort is being concentrated on the easternmost lode, at No. 5 shaft and vicinity.

The mine is now employing about 100 men, and has them very comfortably housed. A townsite was platted, but lots have not sold well, the possible purchasers wishing to see more assurance of permanence than has yet been afforded by developments underground. There are about 30 good dwellings owned by the company, and a considerable number of permanent buildings required in the operation of a mine, including a very large boarding house, 63 feet square and three stories high; a store, well stocked with merchandise; office building, barn, etc. In the way of shops the company has a machine shop and a carpenter shop, each 40 x 48 feet in size, and connected by a power house; a smithy 40 feet square, and a good warehouse, 30 x 67 feet in size. There is also a portable sawmill capable of cutting 20,000 feet of lumber daily, and millions of feet of standing pine, hemlock, cedar, elm, oak and maple. The interior of the office at the mine is finished in oak and elm sawed on the ground.

Feed water for the boilers is furnished from a dam thrown across the head waters of Elm river.

The Elm River is served by the main line of the Copper Range railway, which passes near the mine location.

WYANDOT.

The Wyandot Copper Company was organized in February, 1899, with a capitalization of $2,500,000, divided into 100,000 shares of the par value of $25 each. All stock is issued, and the number of shareholders of record on Dec. 31, 1899, was 681. The main office of the company is at 92 State street, Boston. Henry Stackpole is president, and Wm. O. Gay secretary and treasurer. Matthew Van Orden, of Houghton, is managing director. Frank L. Van Orden, who has acted as engineer of the property from the first work, was promoted to the superintendency in September, 1900, succeeding R. G. Collins. John Biscombe is mining captain. Annual meetings of the corporation are held on the second Monday in May.

The Wyandot property consists of a virgin tract of 1,040 acres, being all of Section 21, the south half of Section 16 and the east half of the southeast quarter of Section 20, in Town 52 North, Range 36 West. The Wyandot has undeveloped mineral lands on the north, east and south, and the Winona on the west. The property is 25 miles from Houghton, by rail and wagon road, and is served by the Copper Range Railroad which crosses the southeastern portion of the tract.

The company was organized with $8 per share paid in, of which amount $500,000 was paid for the lands and $300,000 placed in the treasury for development. The financial statement submitted at the last annual meeting showed that on April 30, 1900, there remained on hand a balance of $179,061.40, in cash and quick assets. There were

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receipts of $8,753 from interest, and total expenditures of $129,601, of which amount $113,771 was at the mine and $15,920 for miscellaneous expenses.

The first work at the Wyandot location was done in February, 1899, but owing to the very severe winter weather prevailing then and for nearly three months thereafter, but little was accomplished until June. The work of locating the northern extension of the Winona amygdaloid was undertaken, with Dr. L. L. Hubbard as consulting engineer. The diamond drill was used extensively, and speedily demonstrated the existence of a phenomenally heavy overburden. So deep was the blanket of sand overlying the rock at most points that no small trouble was experienced in getting stand-pipes down to the ledge, for the drills to work through, and this work proved unusually costly, as well as tedious and discouraging. When a lode believed to be the Winona was finally cut, pits were started along the outcrop, in Sections 16 and 21. The first pit, located about 300 feet from the Elm River boundary, was turned into a shaft, known as No. 1. This has been sunk to a depth of 261 feet. At the first level crosscuts were run 100 feet in each direction, and located an amygdaloid to the southeast which was found badly broken. Another level was sunk and another crosscut sent to this underlying amygdaloid, which was found a little more regular in appearance but lean in copper. A crosscut to the northwest on the same level found an overlying amygdaloid at a distance of 60 feet, but it was also much broken and practically barren of copper. The formation at that point seems much disorganized in all the strata and developments have been unsatisfactory, though occasional patches of well mineralized rock have been encountered. These, however, are not sufficiently numerous to give any promise of profit, though indicating a possibility of more regular measures and better values at greater depth. It is as yet uncertain which of these amygdaloids, if any, is the real Winona lode. This amygdaloid should traverse the Wyandot lands for upwards of one and a half miles, on the strike of the formation, if found where approximately expected. There is a pony hoist and an eight-drill compressor at No. 1 shaft, and a temporary engine and shafthouse.

Pit No. 9 is located about a quarter mile from No. 1, and has been sunk to a depth of about 100 feet. It shows the same broken and unsatisfactory formation encountered in No. 1 shaft.

A crosscut from pit No. 11 cut a twelve-foot lode of amygdaloid at a distance of 50 feet, in October, 1900. This is apparently a little more regular in appearance than the same lode where tapped elsewhere, and carries a fair amount of copper at the point opened by the crosscut.

At present effort is being concentrated on an amygdaloid accidentally uncovered in July, 1900. The diamond drill was searching for something of the sort, plowing through vast quantities of sand, with stand-pipes sunk to the solid ledge, in the attempt, but an employee

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who started to dig a well came down plump on the lode at three feet depth. This illustrates the uncertainties of exploratory work, especially at a property like the Wyandot, which must be tested under the most adverse conditions. A few hundred feet distant from the well the overburden of sand runs 150 and even 200 feet in depth.

The new lode is about a quarter mile east of the Winona amygdaloid, and is showing quite richly in fine copper. While but a limited amount of work has yet been done upon it, and it is impossible to give a very accurate opinion of the lode from the present small amount of opening, it is certainly the most promising of anything yet found on the Wyandot property, and if present conditions should be maintained, may prove a workable deposit. Underlying this new lode there is a wide conglomerate, barren of copper, this being 55 feet east of the newly-opened amygdaloid, at the Wyandot. A similar wide conglomerate has been found underlying the new lode of the Elm River at a depth of 40 feet, and from the relative strike, dip and position of the amygdaloids on these adjoining properties, it seems probable that they are one and the same lode. If this be true, there should be still another amygdaloid underlying the big conglomerate at a distance of approximately 75 feet, at the Wyandot.

The newly opened amygdaloid runs 10 to 20 feet in width. A diamond drill hole was bored in October, about 900 feet north of the first pit, and cut the lode at a depth of 240 feet, the hole being bored at an angle of 60 degrees against the formation. The drill core gave 22 feet of amygdaloid, equal to about 18 feet in cross-section, of which the first nine feet, next to the hanging wall, was well mineralized with fine stamp copper. The lode is about 10 feet wide in the first pit, which was sunk 100 feet, the dip being about 68 degrees with the horizon. The lode was disorganized at surface, as has been the case with the other amygdaloids opened on the Wyandot, but at the depth of 100 feet is becoming quite regular—more so than at similar depth on the other two amygdaloids tested. A crosscut was sent east at a depth of 100 feet, to the underlying conglomerate, and sinking has just been resumed in the shaft. No work is being done at present on the original openings.

A reservoir has been built on high ground, into which water is forced from a spring by a steam pump. The reservoir furnishes water for boilers and the mine location.

The diamond drill is still in regular use, and will eventually give a complete cross-section of the Wyandot tract.

The surface improvements at the property consists of machine and blacksmith shop, carpenter shop, a good office building, supply house, and about a dozen good dwellings, some of log and some of frame construction, with the usual minor structures, such as barns, powder house, ice house, etc.

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WINONA.

The Winona Copper Company was organized on Nov. 3, 1898, and took over the real estate of the old Winona Mining Company, organized in 1864, the affairs of which were wound up in 1897-98, also considerable adjoining land. The capitalization is $2,500,000, divided into 100,000 shares of the par value of $25 each. All stock is issued, and there were 637 shareholders of record on Dec. 31, 1899. The stock was marked $8 per share paid in, of which amount $4.50 per share, or $450,000, was paid for the landed estate of the company, and $350,000 was placed in the treasury for development.

Officers of the Winona Copper Company are as follows: President, John Stanton; secretary, J. Wheeler Hardley; treasurer, John R. Stanton; directors, John Stanton, Wm. A. Paine, Joseph E. Gay, John R. Stanton and James H. Seager, of Michigan. The American Loan & Trust Company, of the Stock Exchange building, Boston, is transfer agent, and the Boston Safe Deposit & Trust Co., of 87 Milk street, Boston, is registrar of the stock. Annual meetings are held on the last Tuesday of March, and the main office of the company is at 11 and 13 William street, New York City. At the mine, F. W. Denton has been in charge of the work, as superintendent, with Wm. Van Orden clerk, and John Wealton mining captain.

Upon the organization of the corporation, the cost of the development work performed under the option on the property was assumed by the Winona company. The following figures are from the sworn report made to the State of Michigan, under date Dec. 31, 1899:

Amount of cash paid in on capital stock.....	$350,000.00
Amount paid in by conveyance of property...	450,000.00
Amount invested in real estate.....	479,972.50
Amount of personal estate.....	119,727.68
Amount of floating debt.....	10,538.34
Amount due corporation.....	670.82

The area of the mineral property is 1,568 acres, lying in two tracts, the larger of which has 1,440 acres, and the smaller, which is separated from the main portion by the Wyandot property, having about 128 acres. A lot of 80 acres, included in the main tract before mentioned, was bought for $200 per acre after the organization of the corporation. The Winona company also owns the standing timber on 1,768 acres in Sections 6, 7 and 18, of 51-36, lying three to five miles south of the mineral lands. The main tract of the Winona is located in Sections 19, 20, 29 and 36, Town 52 North, Range 36 West. One mile east of the main portion, beyond the Wyandot property, is a 200-acre tract, lying on the western shore of a handsome little inland lake. Excepting the Wyandot, on the east, the Winona is practically surrounded by undeveloped mineral lands of St. Mary's Canal Mineral Land Company.

The total expenditures of the company to the end of 1899 amounted to $242,761.57, of which amount the sum of $29,402.59 was reimbursed

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the option-holders for actual expenses incurred in development work from April to November, 1898. Expenditures at the mine from Nov. 1, 1898, to Dec. 31, 1899, were $173,341.97; general expenses, which included Michigan franchise tax, United States revenue tax, legal expenses, registration, listing of the stock on the Boston exchange, and general office expenses and salaries, amounted to $10,044.51. The sum of $29,972.50 was invested in sundry real estate, including the 80-acre tract adjoining the main property hereinbefore mentioned, and $13,222.50 paid for 1,768 acres of stumpage—including surface rights—and a payment of $750, made on account of a millsite. A summary of the mine expenses, taken from the very comprehensive report issued to shareholders at the last annual meeting, is appended, as follows:

Underground expenses	$63,348.11
Surface expenses—less rentals	28,505.78
General expenses—including taxes	15,462.41
Explorations	3,400.43
Construction account at mine	62,625.24
Total	$173,341.97

The construction account was made up of the following items:

Mine buildings	$13,459.51
Other buildings	18,774.29
Freight and teaming	3,026.61
Office equipment, pipe line, etc	2,304.05
Machinery and boilers	17,449.19
Sawmill	7,611.59
Total	$62,625.24

The Winona mine was first opened in 1864, when a single shaft was sunk to slight depth on an amygdaloid lode, and several barrels of copper in small masses taken therefrom. The lode was discovered by a line of Indian pits along the outcrop, from which it was inferred that a considerable amount of copper had been secured by prehistoric miners. Owing to the utter lack of rail communication, but little work was done there. The property was let on tribute in 1880, but there was insufficient mass copper—the only kind the tributor could take—to make the venture profitable, and but little metal was secured. The affairs of the old company were wound up in 1897, preparatory to the reorganization previously mentioned.

Work by Messrs. Wm. A. Paine and the others interested in the option was begun in April, 1898, under great difficulties. All supplies were taken in by wagon road, mainly from Greenland, Ontonagon county, 14 miles distant, but at times the roads in that direction became impassable, and supplies were secured from Houghton, 26 miles

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northwest. The bulk of the equipment of the mine was secured by tote-teams, preceding the completion of the Copper Range railroad, which now runs within a half mile of the shafts, and can easily build spur tracks thereto. The teaming costs were considerable, and work was delayed greatly by poor roads and lack of teams, as well as by the difficulty in getting good labor. In addition to cutting down the old shaft to larger size and deepening it, other pits were opened north and south, on the same lode, and trenching done across the formation to the westward. A diamond drill has been in use much of the time, and has given a great deal of valuable information regarding the strata outcropping on the Winona lands. Some search was made for a rich epidote, said to lie near the Winona amygdaloid, but it has not been located. The Winona bed itself carries a considerable amount of epidote, with the calcite and quartz usually found associated therewith, and most of the copper contained in the lode is found in the form of fine particles with the epidote. The mass and barrel copper supposed to exist in large quantities in the lode has failed to materialize, and unless the Winona amygdaloid greatly changes its characteristics at depth, the copper must be taken almost exclusively in the form of stamp stuff. Why there should have been extensive Indian pits along the surface is rather puzzling. The prehistoric miners had no stamp-mills, judging from their preference for mass lodes, but they certainly did a considerable amount of pitting along the Winona lode.

The Winona company has upwards of one mile of outcrop of the amygdaloid bearing the mine's name. The lode runs from 12 to 35 feet wide, being above the average thickness, and dips at an angle of 70 degrees, with a strike of about North 59 degrees East. The copper is very fine, but is apparently in nodules, rather than flakes, so could be saved in the mill. Fine flake copper is nearly as difficult to save as flour gold, floating away with the sands, on and in the water used in washing at the jigs and slime-tables. The formation is much disturbed, in the Winona district, this statement applying to the Wyandot and Elm River, as well as to the Winona.

Considerable trenching and test-pitting have been done, in addition to the drill borings, in the past three seasons, and the Winona has obtained a fairly comprehensive cross-section of its lands to the west of the outcrop of the Winona amygdaloid. This work has been rendered difficult, in the past two seasons, by abnormal rains, which have seeped into the pits and trenches, through the light sandy soil. Several copper-bearing amygdaloids have been located, but none of them carry metal in promising amounts. The entire formation in the Winona district is puzzling, being so much disorganized that it is difficult to follow the lodes, and impossible to judge what the next foot of opening will bring forth. There is more regularity in the bottom levels than near surface. The Winona and its neighbors labor under the great disadvantage of opening strata which are unidentified either with the lodes of the Portage Lake District to the north, or with

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the copper-bearing beds of the Evergreen district, in which the Adventure and Mass are operating.

Four shafts are opened on the Winona lode, of which two are of considerable depth, while two are merely exploring shafts. There are also a number of exploring pits, mostly of shallow depth. No. 1, the original shaft, opened in 1864, is located in the northeast quarter of the northwest quarter of Section 29, and is approximately 500 feet in depth. It is 8 x 18 feet in size, inside of timbers, with a skip-way on either side, and ladder-way in the center. Some heavy copper has been encountered in the northern drifts of this shaft, but most of the good rock is in the form of stamp stuff. No. 2 is 900 feet northeast of No. 1 and has no first level, owing to being opened on lower ground than No. 1. Some small masses and barrel work have been found in this shaft, also a considerable amount of promising stamp-rock. Drifting is now in progress both north and south, on three levels in this shaft, and at present it is the most active and promising portion of the mine. The shaft was rich for a short distance from surface, then turned poor for over a hundred feet, and is growing better on the bottom. It is evident from the work already done on the lode that the Winona is decidedly bunchy.

No. 4 is the northernmost shaft, and crosscutting is now in progress on the bottom. Frequent short crosscuts have been driven in the various shafts, to enable the miners to get their bearings, as the entire formation is puzzling. No. 1 shaft is 1,350 feet southwest of No. 4; No. 2 is 900 feet southwest of No. 1, and No. 3 is 1,500 feet southwest of No. 2. There are also several exploring pits between and beyond the shafts. All permanent shafts are 8 x 18 feet in size. No. 1 shaft is sunk at an angle of 72 degrees, the others at 70 degrees. The Winona now has considerably more than a mile of underground openings, and some promising stopes, as well as a number that are not promising. The exact value of the mine can not be determined until a careful stamp-test of a considerable quantity of rock has shown exactly what the lode can be depended on to give. Options vary radically as to the percentage of copper carried, and only a mill-test can settle the question.

The engine house for both shafts is located midway between 1 and 2. The building is of steel frame, on stone foundations, covered with corrugated iron, and is 40 feet square. It houses a double hoist with drums 5 feet in diameter, each carrying 800 feet of one-inch steel cable, and there is room for an additional hoist of the same size. In the same building is a "class A" two-stage straight-line air compressor of Ingersoll-Sergeant make, of 12-drill capacity, also a one-stage compressor of the same capacity, the latter second-hand, but in good condition. There is a boiler house adjoining, also of steel, 40 x 48 feet in size, in which are four horizontal boilers, rated at 80 horse-power each, with room for additional boilers when required. The equipments at the other openings are pony hoists in temporary buildings,

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and headgears over the shafts. Fifteen power drills are owned by the mine.

A valuable asset of the company is found in a second-hand sawmill bought at a bargain. The mill plant contains considerable machinery not yet used, but which will eventually come very handy. The mill is housed in a frame building 32 x 70 feet in size, with a wing 42 x 66 for the boilers and another wing 16 x 46 feet, in which is a shingle mill, also a smithy 12 feet square. The daily capacity is about 20,000 feet of sawed lumber, and as the company owns nearly 3,500 acres of land, most of which is densely timbered, the mill will bring in considerable revenue for lumber sold, as well as meeting all requirements of the mine for building and underground purposes. The standing timber is mainly maple and other hardwoods, but with a sprinkling of pine, hemlock and cedar. It seems a scandal to see the beautiful curly and bird's-eye maple so freely found between Houghton and the Ontonagon river, used as every day firewood, under mine boilers and in miners' kitchen stoves. Some day a wise man will make a fortune from this wood, and it will no longer be wasted to furnish the heat that could as readily be supplied by more plebeian varieties of timber.

The mine buildings include a warehouse 26 x 40 feet; carpenter shop 20 x 40; blacksmith shop 22 x 34; mine store 30 x 40, replacing a smaller building burned last winter; a commodious office; superintendent's residence; barns; two boarding houses, and about 30 dwellings. Most of the frame structures have been erected from lumber sawed out of the company's logs by the company's mill, and roofed with home-made company's shingles. The buildings are well constructed and the location is a pleasant one. A townsite was platted about a year ago, and if the mine becomes profitable, will become the nucleus of a considerable population.

ADVENTURE.

The Adventure Consolidated Copper Company was organized October 17, 1898, under the laws of Michigan, with a capitalization of $2,500,000, divided into 100,000 shares of the par value of $25 each. Five dollars per share was paid in on organization, of which $250,000 went for the lands and $250,000 was placed in the treasury. The number of shareholders of record on Dec. 31, 1899, was 1,046.

Officers of the company are as follows: President, T. Henry Mason; secretary and treasurer, Wm. R. Todd; assistant secretary and treasurer, W. A. O. Paul; directors, T. H. Mason, Chas. J. Devereaux, Isaac H. Meserve, Henry A. Wyman, Wm. R. Todd and Thos. B. Dunstan, of Michigan. The main office is at 45 Broadway, New York City. The Old Colony Trust Company, of Boston, is transfer agent. At the mine, P. R. Robert, who was in charge of the Atlantic many years ago, is agent, succeeding Capt. S. B. Harris, of the Quincy, who was agent and Mr. B. F. Chynoweth, who was superintendent. Thomas Trevorrow is mining captain, and S. A. Prince is clerk.

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The present Adventure Consolidated is made up of the old Adventure and Hilton mines, in one tract, and the old Knowlton mine in a second tract lying a mile southwest of the main portion of the mine. The area of these mines is as follows:

	Acres.
Adventure	779.57
Hilton	320.00
Knowlton	596.75
Total mineral area	1,696.22
Millsite on Lake Superior	223.90
Total landed estate	1,920.22

The mineral lands of the company are located in Sections 35 and 36, Town 51 North, Range 38 West, and in Sections 1 and 2 of Town 50 North, Range 39 West. The Toltec and a fragment of the Belt property lie on the north; the Aztec on the east; Toltec and Mass on the south, and the Mass on the west of the main tract. The smaller, or Knowlton tract, to the southwest, has the Mass Consolidated to the north and east; the Flint Steel to the south and the Superior, now owned by the Michigan, to the west. The village of Greenland lies on the northwestern corner of the principal tract of the Adventure, about two miles by wagon road from the main workings, and the village of Maple Grove, controlled by the company, is near the mine. The Ridge mine of the Mass company, on which that corporation is now concentrating its energies, lies between the old Adventure and Knowlton mines of the Adventure company.

The following items relating to the finances of the Adventure company are from the sworn return to the state, under date Dec. 31, 1899:

Amount of cash paid in on capital stock	$500,000.00
Amount paid in by conveyance of property	.....
Amount invested in real estate	250,000.00
Amount of personal estate	139,850.99
Amount of floating debt	.....
Amount due corporation	.....

According to the treasurer's report read at the last annual meeting, the receipts of the company from its formation to the close of 1899 were $4,023.95, from interest; with expenditures of $114,172.96, for all purposes. The figures of expenditures are not itemized. An assessment of $3 per share, payable in one dollar installments in August and December, 1899, and April, 1901, was levied in June, 1900, which will give a total of $550,000 for the opening and equipment of the mine.

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The old Adventure mine was opened in 1850. Its largest production was in 1857, when 116 tons 1,941 pounds of refined copper were obtained. It was originally opened on the Butler (or Champion) lode, but later work was done on the Knowlton bed. A long line of pits was found along the outcrop of the Knowlton, and on several of the adjoining beds, by the first white men to visit the property, showing that this mine, with its neighbor, the Ridge, had been a favorite mining field of prehistoric races. For forty years the Adventure has been gophered by tributors, in search of both copper and silver, and while some have failed in their quest, many have succeeded. One adit is shown, from which two men took out $3,000 worth of native silver in a single night, so the story runs. The tale may have grown with years, but it is certain that the mine was always prolific in silver, as well as mass copper. A mass of native copper weighing 24 tons was taken from the Adventure, by tributors, a few months before the organization of the present company, and in fact had much to do with interesting capital in the venture. A property that yields twenty-four ton masses, after forty years of desultory searching above the water level, cannot be altogether worthless.

Adjoining the Adventure mine proper, on the east, is the Hilton, carrying the same lodes. This was once known as the Ohio, but was never worked in any but the most primitive fashion, with hand drills, black powder, and hand or horse whims, the first throb of a steam engine having yet to be heard at its two shafts, each of which is less than 100 feet in depth, with two or three hundred feet of drifts opened on the first, or ten-fathom level. In the early days all mining work was measured by fathoms—a length of six feet. The word is now used as a measure for stoping ground, a fathom meaning a cube of six feet, or 216 cubic feet of rock, weighing about 18 tons. The Hilton was opened in 1863, on the Mass lode, and some opening was done later on the Knowlton lode, by tributors.

The Knowlton, lying southwest of the Ridge, was opened in 1853. Since 1865 the mine has been worked to some extent, off and on, by tributors. There are three shafts, all on the Knowlton lode, sunk to depths of 100, 240 and 200 feet, respectively. The property is considered promising and will be given attention later, but probably not until the Adventure has started its mill and got the present shafts opened well ahead of requirements. The Knowlton carries the same lodes as the Adventure and Hilton mines.

The production of refined copper by the three mines in the Adventure consolidation has been as follows, according to the official records:

Adventure	598 tons,	134 pounds.
Knowlton	323 "	1,993 "
Hilton	52 "	1,046 "
Total	975 "	373 "

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Added to these figures there should be at least 50 tons, and perhaps 100 tons for production by tributors in the past ten years, the records of the production of smaller mines having been bunched under the heading "miscellaneous" since 1890. The first production of the Adventure Consolidated was made early in November, 1900, when 18 tons of mass and barrel work, accumulated at the shafts from opening work, were sent to the Quincy smelter, and gave returns of 12 tons ingot, worth about $4,000. A considerable number of masses, ranging in weight from 250 to 4,000 pounds, have been secured at various points, in reopening the old Adventure shafts and adits.

Work was begun by the present company on Nov. 1, 1898, when the unwatering of No. 1 shaft of the Adventure mine on the Knowlton lode was begun. Like all the other new and reopened properties, the mine was forced to spend a great deal of money to make a small showing, during its first year. The old buildings had gone to ruin, the machinery was worthless or had disappeared entirely, and about all that was left was a choice collection of shafts, adits, drifts and winzes, located almost at random, and looking like a Chinese puzzle. The old maps were unreliable, and every foot of progress made had to be gained with great caution and patience. In 1900 the mine has been put fairly on its feet, and has secured much greater results per dollar of expenditure than during the first fifteen months of work.

In the Ontonagon county mines of the Greenland-Rockland district, there are two parallel belts of copper-bearing strata, separated by perhaps half a mile of ground on which very little work has ever been done, and which, so far as known, contain no workable beds of cupriferous rock. The northern copper bearing system is known as the North, or Minnesota belt, and is opened by the Minnesota (now Michigan), National, Rockland and sundry mines of less importance. The southern formation is usually called the Evergreen belt, or South Range, and on this latter series of parallel amygdaloids the various mines contained in the Adventure and Mass consolidations are opened. The topography at the Adventure is strikingly bold and of considerable natural charm. Adventure Bluff rises to a height of about 350 feet, with one sloping and one precipitous face. It is cut by Adventure Gap, through which flows Adventure Creek, to the eastward of No. 3 shaft of the mine. At this point the trap formation has a trend of almost east and west, the strike of the lodes being approximately N. 73 degrees E., or 10 degrees more easterly than at the Baltic, yet less than two miles southwest the formation has a strike of about N. 32 degrees E., at the Ridge mine, showing a curvature of trend amounting to more than forty degrees in less than two miles. The average dip at the Adventure is about 40 degrees.

Down the escarpment of this bluff are located the parallel outcrops of the copper-bearing beds, in step-ladder form. The cupriferous lodes are all amygdaloidal, none of the conglomerate strata in the district having been found to contain copper. The seven lodes carrying copper have been named as follows, from north to south:

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1. Knowlton. This is the bed on which the shafts of the mine are being opened. It runs from 4 to 28 feet in width, at various points, and possesses an average width of about ten feet. The rock is rich in epidote, chlorite, prehnite and the minerals commonly found associated with these, in the Keweenawan series. A considerable proportion of the product from this lode, perhaps a quarter, will be found in the form of heavy copper.

2. Merchants. This bed underlies the Knowlton amygdaloid at a distance of only 20 to 65 feet, in cross-section. It is a stamp-lode, but has produced masses up to 500 pounds weight. It has been opened by crosscuts and several hundred feet of drifting done upon it, but has not come up to the expectations formed when it was first opened. It will probably average about ten feet in width. It was first opened in 1856.

3. Mass. This is a continuation of the same lode found at the Ridge, but is a poor sort of bed where opened on the old Adventure. It carries no large masses of copper and has but little stamp rock. In the Hilton, to the east, the Mass lode shows good rock, as it also does in the Knowlton, to the southwest. The lode will probably be valuable to the Adventure Consolidated at other points than at the old Adventure. It averages about 10 feet wide and lies about 100 feet south of the Merchants, measured on the floor of the adits.

4. North Butler. This bed lies nearly 100 feet south of the Mass, and but little is known of it further than that it carries some copper. It has never been tested sufficiently to learn its real worth, having been discovered but a few weeks ago.

5. Butler. This is sometimes called the Champion, and is the widest and most vigorous amygdaloid on the property. It ranges from 12 to 50 feet in width, with an average of probably close to 20 feet. It lies nearly 200 feet south of the North Butler, and ranges in value from very rich to absolutely valueless. It carries masses to a considerable extent, but in proportion to its great width will give but a small amount of stamp rock, though fine stopes are occasionally opened. Being so wide, it can be mined cheaply. This lode has always been noted for its richness in silver. The amygdaloid apparently has a felsite base, and is chemically and mineralogically quite different from the parallel strata on either side, which bear a sort of family resemblance. About 2,000 feet of opening work has been done on this lode, or practically as much as on the Knowlton, and it is from the Knowlton and Butler beds that the owners look to get their copper mainly.

6. Ogima. This lode lies about 100 feet south of the Butler, and has been but little opened on the Adventure.

7. Evergreen. This lode lies about 250 feet south of the footwall of the Ogima, and like the latter, has been but little opened on the Adventure tract. It will average at least 10 feet wide, and has produced considerable copper at adjoining mines.

In a distance of less than a quarter mile, from north to south, the

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Adventure has seven copper-bearing amygdaloids, five of which have produced copper on this and adjoining properties. The principal trouble at the Adventure, as at all other mines operating on the lodes of the Evergreen range, arises from the bunchy nature of the lodes, and the irregularity in walls and beds which is a feature of the district. It is evident that much the best plan of mining is the one adopted by the present management, of opening a great extent of ground, and looking for the law of averages to furnish enough stoping ground of good grade to feed a mill. The Adventure should show a high percentage in the mill, partly because of its large amount of heavy copper, and partly by reason of its rock being divided sharply into two classes —very good and very bad. The good rock is so rich that there can be no question as to its value, and the poor rock is so obviously lean that little money will be wasted in trying to pound copper out of it.

There are three shafts, all opened on the Knowlton lode, and numbered from west to east. No. 1 is the old No. 1 of the Adventure, cut down, straightened and retimbered to the bottom in 1899, and since sunk deeper. It is now sinking for the fourth level, and is 7 x 18 feet inside and has three compartments. There is a new engine house, built in the winter of 1899–1900, and a Nordberg duplex hoist good for a quarter mile in depth. Steam is furnished by two large horizontal boilers of Burt manufacture.

No. 2 was started as an air shaft, but owing to the long stretch of ground between 1 and 3, has been made into a permanent working shaft of two compartments, 6 x 12 inside of timbers. Sinking for the fourth level has just been resumed. A crosscut has been driven from this shaft to the Butler lode, on the second level.

No. 3 is of the same size and capacity as No. 1. It was sunk for the first 150 feet under difficulties, the miners having to fight both sand and water for the entire distance. The solid ledge was not reached until the third level, which is 168 feet below the collar of the shaft. The shallow depth of the third level—which is the first level so far as this shaft is concerned—is due to the great hill which provides room for two levels above, on the Butler lode. A crosscut is now being driven to the Butler.

East of No. 3 there is a deep overburden of sand, and also Adventure Gap to cross. The difficult engineering and mining problems found at this point have made the management hesitate to start No. 4 shaft, and it is possible that the fourth shaft will be located after No. 3 has reached sufficient depth, say the fifth level, to drift under the gap to the site of the new shaft, for an upraise. The surface showing on the Knowlton lode 2,000 feet east of No. 3 is excellent. No. 3 is equipped with a good Nordberg hoist, two 125-horse power Burt boilers, a 20-drill Rand compressor and feed-water heater, covered by a frame building 32 x 48, with an ell 18 x 36 feet in size.

The plan of mining at the Adventure is somewhat unusual, and has been adopted because of the peculiar conditions imposed by the

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existence of a number of parallel copper-bearing strata and the high hill on which some of the lodes outcrop. The Butler lode has been reached by four crosscuts, which are really adits, as they open on surface. The high back, averaging about 250 feet above the level of the shafts, will permit the removal of a vast amount of ground without hoisting, as the rock broken can be trammed through the drifts and crosscuts directly to the mouths of the shafts on the Knowlton lode. The dip of the shafts is 45 degrees. No. 3 shaft is really sunk under the Knowlton, in the foot, but the bulging of the lode has brought the shaft into the amygdaloid at the third level.

Sixteen drills are in use underground, power for which is furnished by the new 20-drill compressor and an old 10-drill compressor.

The preliminary work being well over, good progress is being made in opening underground. Last month—October, 1900—no less than 650 feet of drifting was done, in addition to about 75 feet of sinking. Despite the long stretches of poor ground in the mine, some fine stopes have been opened, and are ready for production whenever the mill is built. Everything at the mine is in readiness for production, except the rockhouses at the shafts, and these can be furnished on short notice, when needed.

Owing to the large amount of silver carried by the Adventure, it is probable that this mine will follow the example of the Quincy and refine certain grades of mineral electrolytically. This is especially probable in view of the likelihood that the Adventure mineral will be refined at the Quincy smelter, both mines being under the same eastern management. It is also quite likely that the old rock burrows will be sorted over, and a considerable portion of the rock discarded by tributors sent to mill. The tributors had no stamping facilities for many years, and threw out not only some fine stamp rock, but considerable heavy copper. This was shown by several barrels of copper being secured out of waste rock from burrows put through a crusher last summer, to furnish material for dressing the roads about the mine.

The mine is well equipped with buildings, all of frame construction, and all painted red. The list includes three engine houses, three shaft-houses, a compressor house, office building, warehouse, "drys," machine shop, carpenter shop, blacksmith shop, and nearly 30 dwellings. There is also a boarding house 26 x 92 feet in size and two stories high. At present about 140 men are employed, one-half underground and half on surface. A pump on Adventure Creek forces water to a reservoir on Adventure Bluff, whence it is distributed through mains to the mine buildings, and hydrants are placed for fire protection.

The Adventure property is crossed by three railroads, the Chicago, Milwaukee & St. Paul; Copper Range, and Mineral Range.

The company owns a millsite of 224 acres on the shore of Lake Superior, with one mile frontage, about 4 miles east of Ontonagon, but may build at some other point, either on Lake Superior or Keweenaw Bay. With underground openings being made at the rate of two

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miles per year, a mill must soon be planned. It is just as well that the mill has not been rushed, for the Adventure lodes are so bunchy that the mine must be opened far ahead to supply a mill with well selected rock, but with the mine properly opened it can be made to show a much higher return of ingot copper per ton of rock stamped than is averaged by the amygdaloid mines of the district.

MASS CONSOLIDATED.

The organization of the Mass Consolidated Mining Company, of Michigan, was effected early in 1899. The corporation has 100,000 shares of the par value of $25 each, all issued: and on December 31, 1899, had 477 shareholders of record. The main office is at 16 State street, Boston, Mass., and annual meetings of shareholders are held on the second day of February (if not dies non) each year.

Officers of the company are as follows: President, Edward E. Floyd; secretary and treasurer, Chas. H. Bennett; directors, Edward E. Floyd, Sydney Harwood, A. B. Turner, S. D. Whittemore and J. Walter Davis of Boston, and Fred H. Begole, Thos. F. Cole, Samuel Mitchell and A. Mathews, of Michigan. Thos. F. Cole, of Ironwood, is general manager; A. Mathews, of Marquette, is agent; R. R. Trezona, at Mass City, is superintendent: Samuel Gourd, mining captain; W. A. Brown, clerk; E. V. Palmer, mining engineer.

At the time of the organization $8 per share was paid in, and of the proceeds $550,000 was paid for the five mines entering into the consolidation, and $250,000 was placed in the treasury for development. Assessments of one dollar each were called in February and September, 1900. A third assessment of one dollar may be required to put the mine and mill in running order, but the management believes that the work can be done without asking shareholders for more money.

The following figures relating to the finances of the Mass are from the sworn statement returned to the State of Michigan, under date December 31, 1899:

Amount of cash paid in on capital stock	$800,000.00
Amount invested in real estate	573,893.16
Amount of personal estate	69,539.90
Amount of floating indebtedness	10,413.19
Amount due corporation	119,500.00

The report of the directory to shareholders at the last annual meeting, in February, 1900, showed an income for 1899 of $14,367.31, made up of two items. From the sale of copper produced that year, $8,069.03 was received, and from interest on its deposits the treasury gained $6,298.28. Expenditures for all purposes aggregated $141,799.98, of which amount $128,043.55 was spent at the mine, and the balance for smelting, brokerage, salaries, registration and transfers of stock, and general office expenses. A carefully detailed statement is given,

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showing all costs at the mine, from which it is learned that the total underground expense for the year 1899 amounted to $66,565.39. For mine structures and equipments the outlay was $14,866.83; for boarding houses and tenement dwellings for employees, $15,892.20 was spent; and for miscellaneous surface expenses, the sum laid out was $12,657.98, the latter amount including an item of $4,075.68 for repairing old dwellings which should have been charged to construction account, together with the expenditures for boarding houses and dwellings.

The Mass Consolidated property, as now constituted, is very irregular, but fairly compact, all of the various tracts being joined. The mineral property consists of a trifle more than 2,400 acres, all on the copper belt, lying in Sections 33, 34 and 35, Town 51 North, Range 38 West; Sections 4, 5, 6 and 7, Town 50 North, Range 38 West; and in Section 1, Town 50 North, Range 39 West. The property is not so badly scattered as might be inferred from the description, as the correction line between towns 50 and 51 swings the former tier of towns more than two and a half miles west of the position occupied by the corresponding range in 51. The Mass Consolidated is bounded on the north by lands of the Union Copper Land & Mining Company, the Adventure, and farm lands adjoining the village of Greenland; on the east by the Adventure, Toltec and Evergreen mines; on the south by the Flint Steel and the Knowlton mine of the Adventure Consolidated, and on the west by the Flint Steel, Adventure, and undeveloped mineral lands owned by St. Mary's Canal Mineral Land Co.

The Mass Consolidated is made up of five old mines, the Ridge, Mass, Ogima, Merrimac and Hazard, these being given in the order of their importance in the past. The production of these mines has been as follows, according to the somewhat imperfect records at my command. The figures of production of a number of smaller mines for about five years preceeding 1895 are not all recorded, and it is probable that a credit of fifty tons each could safely be allowed the Mass and Ridge, in excess of the following figures. I hope to have these, as well as all other figures of copper production, complete for the next volume of this work:

Mine.	Tons.	Pounds.
Ridge	2,567	449
Mass	2,507	266
Ogima	491	308
Merrimac	....	...
Hazard	....	...
Total	5,565	1,023

In 1899 the Mass Consolidated produced 21 tons, 800 pounds of refined copper, secured from mass and barrel work met in opening the mine, and to date has probably produced a little less than 100 tons, all secured from shafts, drifts and crosscuts, the value of which would be

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nearly or quite $30,000. The three mines that produced copper previous to the consolidation had mills, all of antiquated pattern, with gravity stamps, and utterly unfitted to dress copper in the present age. All have been or soon will be demolished, and the old machinery, other than shafting and pulleys, sold for junk.

In consolidating the five mines a block of 10,000 shares of stock in the Ogima company, owned by W. K. Prudden, of Lansing, Mich., was overlooked. Rumors that the Mass Consolidated had no adequate title to its lands were spread because of this, but a satisfactory arrangement has been reached between the company and Mr. Prudden, by which his stock has been purchased by the Mass company, and the flaw in the title corrected.

The most important work of the present company is now under way at the Ridge mine. This mine paid dividends of $100,000, from mass and barrel copper and stamp-copper secured by an old mill with twelve Gates gravity stamps. Any property that could do that possesses merit in a considerable degree. This was one of the first mines opened in the Ontonagon district, mining having begun in 1850. The largest annual production was in 1874, when 187 tons 113 pounds of ingot were produced. The property was originally bought for $800. The company worked the mine five years, then leased it to Stephen Martin, who worked it five years longer, at a profit, until the mine was bought for $200,000 by the late Thos. F. Mason, in 1860. A new company was organized and expended $200,000 secured by assessments. Under the management of Capt. S. B. Harris, now of the Quincy, the property paid dividends of $100,000. It is the only mine in Ontonagon county that has ever paid a dividend from an amygdaloid lode, but several others have proven highly profitable to tributors, though failures in the hands of the corporations owning them. Capt. Harris asked for $50,000 to make improvements imperatively demanded in 1881, and the directors gave him $10,000. This being insufficient, the property fell back into the ranks of the "has-been" class. It could probably have been kept working and made a fine mine, but for the parsimony of shareholders who insisted on taking the profits as fast as made, when profits were earned, and dribbled money back in grudging installments, always too small, when cash was required to keep the mine alive.

The Ridge was originally opened by three shafts on the Evergreen lode, the southernmost of the series, and also had a shaft on the Butler, or Champion lode, next northwest. No. 1 shaft was down only 100 feet, to the second level, but No. 2 was 600 and No. 3 was 710 feet in depth. In 1882, working with hand-drills, black powder and all the old inconveniences, mining costs were as follows: Sinking shafts, $40 per foot; drifting, $10 per foot: stoping, $19.38 per cubic fathom. In 1899 it cost an average of $50.75 per foot to sink shafts, which were more than twice as large as the old ones, and drifting cost $7.10 per foot. These costs have been smaller for 1900, and when the mill starts, stoping can

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probably be done for $6 to $7 per fathom, and at even lower figures later. The contract price for sinking was only $20 per foot in 1899, but the cost of timbering, temporary buildings and hoisting was added to secure the average price first named. In the early eighties, only one-fifth of the rock mined was stamped, and this yielded about 8-10 of one per cent ingot. As the heavy copper was practically double the amount secured from stamping, the average return per ton of rock treated was about 2½ per cent. With the utterly inadequate milling facilities possessed by the mine, it was necessary to secure a high return to pay for the cost of operation. In modern practice practically everything carrying one-half per cent or better would be put through the stamps, after the heavy copper had been removed.

The Mass mine was opened in 1856. It possesses the same lodes as the Ridge, and was opened by six shallow shafts on the Evergreen bed. It was first opened on the Mass lode, next on the Butler, then on the Knowlton, and finally on the Evergreen. In the shafts on the latter the footwalls are much broken, trap and amygdaloid running into each other in a very perplexing manner. The hanging walls are clearly defined, as a rule, and miners have been guided by them in opening the various levels. There is also a fault of 25 to 30 feet in the formation, which offsets all the lodes, so far as known. The Mass was opened in 1856, closed in 1860; reopened 1864, closed 1868; reopened again in 1874, and after various mutations again closed in 1886, since which it has produced a few tons annually, secured by tributors working above the adit level. The Mass never paid a dividend, though erroneous claims to that effect have been advanced. In 1879 forty per cent of the rock hoisted was rejected, and the balance gave 40 pounds of mineral per ton—better than one and a half per cent ingot. In 1882 the rock stamped returned 1 5/100 per cent ingot, not inclusive of heavy copper. The old Mass company sunk about $150,000 in all, secured from various assessments levied on shareholders.

The Ogima mine was opened in 1860, in the northwest quarter of Section 6, Town 50 North, Range 38 West, on the Ogima lode, the outcrop of which was plainly marked by a line of Indian pits, and was closed in 1868, since which copper has been secured to a limited extent by tributors scramming in the upper levels. It has two shafts, each about 200 feet in depth. The net cost of the venture to the shareholders was about $140,000.

The Merrimac consists of a 40-acre tract just north of the Ogima. The company was organized in 1863, and managed to go through $117,000. The property carries the underlay but not the outcrop of the cupriferous beds of the Evergreen belt, and all that the shareholders had to show for the considerable expenditure were two vertical shafts, each less than 100 feet in depth. Where the money went to cannot be seen, at this late day.

The Hazard did a little work on the North Range, or Minnesota belt, but not enough to determine anything as to the value of the

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strata at that point. A few old test pits and shallow shafts alone remain to show the modest expenditure made nearly forty years ago.

The Mass Consolidated has the five-copper bearing amygdaloids of the Evergreen Range, which average probably 10 to 12 feet wide, but vary greatly from point to point. The entire formation is much broken here, as it is to the northeast, on the Adventure lands. The belt of cupriferous strata enters the Mass tract from the northeast, with a strike of about N. 72 degrees E., but takes a sharp turn to the south, almost as soon as over the boundary line, with a strike averaging N. 37 degrees E. The dip varies from 38 degrees on the Ridge to as sharp as 47 degrees on the Mass. The lodes, in order from north to south, run as follows: First, the Knowlton; Mass, 140 feet south; Butler, 300 feet south; Ogima, 100 feet south; Evergreen 250 feet south. These measurements vary from point to point, but the preceding figures give a fair average of the distances intervening between the various mineralized beds. The Mass Consolidated has the outcrop of this series of lodes for an average distance of perhaps one and a half miles —equal to seven and a half miles of outcrop on a single lode averaging 10 to 12 feet wide. The territory gives ample room for a deeper mine than it is possible to open with present appliances for cooling levels below one mile in vertical depth. The Adventure has just found a sixth lode, called the North Butler. Whether the Mass will get it also is uncertain.

The leading characteristics of these five lodes, where opened on the Mass Consolidated Company's various mines, seems as follows: The Knowlton carries both heavy copper and stamp rock, but has not been extensively opened. The Mass lode has both heavy copper and stamp rock, but apparently not enough of either. The Butler is a wide, strong lode, bunchy, but very rich at points, yielding both mass and stamp copper, though mainly the latter. The Ogima is a stamp lode, with a little barrel work and occasional small masses. The Evergreen gives some heavy copper, but a larger amount of stamp rock. In point of promise, as they now appear, the lodes would be ranked as follows: Evergreen first, with the Butler a good second; Knowlton third, Ogima fourth and Mass fifth. The Evergreen is sometimes called the Ridge lode, and the amygdaloid called the Merchants, which lies under the trap footwall of the Knowlton bed at the Adventure property, is missing on the Mass lands, so far as exploited. The Butler lode runs 12 to 30 feet wide where opened, and is unquestionably the strongest of the parallel copper-bearing amygdaloids of the Evergreen belt. The Ogima runs 10 to 25 feet in width, but does not show very good ground where opened, so far. The Evergreen, or bottom lode of the series, runs as narrow as 4 feet and as wide as 40, on the Mass lands. It is richest where of considerable width.

The old Mass mine was notably rich in silver, and the Ridge also yielded considerable quantities of this metal, though neither gave so much silver as the Adventure.

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Work at the Mass Consolidated was begun at No. 3 shaft of the old Ridge mine, now known as the Ridge shaft, which was 710 feet deep, and had seven levels opened. Timbers were badly rotted, and the work of reopening was slow at first. Old boilers and engines were pressed into service, and the first work at the mine was done with as small expenditure for machinery and material as at any other mine recently reopened in the Lake copper district. This shaft is now down about 900 feet, and there are some fine stopes opened on the Evergreen lode, as well as considerable stretches of barren ground. Some of the best stopes in this shaft are fully 20 feet wide, and rich. In sinking for the tenth level, quite recently, three tons of heavy copper were secured in 20 feet. In a crosscut from the seventh level 1,500 pounds of mass copper were secured in passing through the Butler lode, which is about 11 feet wide at that point—equal to about 2½ per cent refined copper, in mass and barrel work alone. On the fourth level crosscut from this shaft the Ogima lode shows a 12-foot bed of good stamp rock—the most encouraging showing so far secured on the Ogima. The eighth level crosscut from the Ridge shaft reached the Butler lode Nov. 15, 1900, and found it rich where cut, showing both heavy copper and stamp-rock in considerable quantities. A crosscut is being driven 85 feet west of this shaft to prove all of the lodes to the north. This is on the seventh level, and a similar crosscut from a point 1,000 feet to the west will also open the entire formation, and the northwestern ends of the crosscuts will be joined by a drift on the Knowlton, thus blocking out a single square of nearly 1,000 feet, on this level. The plan of mining is much the same as has been adopted by the Adventure. The parallel lodes lying so close together—all within easy tramming distance—they will be opened by crosscuts, and all hoisting for the five done from the nearest available shaft, regardless of which lode it is sunk upon.

The "Ridge" shaft being the first and principal shaft of the mine, is receiving the first permanent equipment and the heaviest machinery. A frame shafthouse of large size is to be erected at once. This will be practically a duplicate of the shafthouse over No. 6 Osceola, and will be 44 x 62 feet on the ground and 80 feet high. It will be fitted with two Blake crushers with 22 x 28 inch jaw openings, and a steam hammer, with room for two additional crushers, if required. The rock-bins will hold 600 tons, and railroad tracks will pass underneath. The new machinery plant occupies a site very near the old stampmill of the Ridge. The building is 48 x 120 feet, of frame, and is to cover hoists, boilers and compressor. Power will be furnished by two 250-horse power Stirling water-tube boilers, with room for two more when needed. The hoist will have two drums, each 10 feet in diameter with 11-foot face, grooved for inch-and-a-quarter steel cable, capable of raising four-ton loads at the rate of 1,500 feet per minute from a half-mile depth. The compressor will be one of the best in the district, a two-stage cross-compound, of Rand make. By cross-connection a breakdown is rendered almost impossible. Compressed air is the life

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blood of a mine, just as truly as coal is its food, and a defective air-supply means troubles of frequent recurrence and serious consequences.

The "New Ridge," or "B" shaft, located 1,000 feet southwest of the "Ridge" and also opened on the Evergreen lode, was begun in the fall of 1899. It is of three-compartment size, 7 x 20 inside of timbers, and has a temporary plant. It passed through nearly 90 feet of overburden, but is timbered to withstand any pressure, and is now nearly 700 feet in depth.

There are two other shafts, the "Merrimac," opened about 1,000 feet southwest of the "New Ridge," on the Knowlton lode, and the "Ogima," 1,000 feet south and west of the "Merrimac." Owing to the peculiar configuration of the tract, and the lay of the land, these shafts are located at the other end of the series of amygdaloids, on the Knowlton, or northernmost lode. They are of permanent construction, three-compartment size, and designed for opening all five lodes, on a plan similar to that prepared for the Ridge shafts. They were started last spring, and are as yet comparatively shallow, but will be heard from in 1901.

At the present writing the Mass has about a mile of new drifts, nearly half a mile of crosscuts, and upwards of a quarter mile of shafts. The shafts and crosscuts afford no stoping ground, though they develop the mine in such a manner that stopes can be quickly opened. The crosscuts tap so many parallel lodes that it will be possible to begin drifting at a remarkably large number of points at one time, and there are probably none of the other new mines where machines can be set at work at so many different places, on short notice, as in the Mass Consolidated. It is presumably for this reason that the management reduced its force to less than 50 men, in August, 1900. I am of the opinion, however, that it would have been wiser to have continued opening shafts and drifts, even though such work would have necessitated calling on the shareholders for more money than has been demanded. Even one stamp eats up a great deal of rock in these days, and the Mass property is so irregular in the width and richness of its stopes that a great many of them must be opened ahead of the mill, to allow a judicious selection of rock. Both Messrs. Cole and Matthews, the general manager and the agent, are iron mining men. They are accustomed to considering a hundred thousand dollars as a very large sum of money. Half of that amount will open and equip a large iron mine, in Michigan, but $50,000 would be wasted in anything short of another Calumet & Hecla, in the Lake Superior copper district. The experience of the past three years has shown plainly that a half million dollars is the minimum sum for which a copper mine can be properly opened and equipped, in this district. Both Messrs. Cole and Matthews underestimated the cost of making the Mass a producer—but for that matter a similar mistake has been made at nearly every other new or reopened property in the district—and they are trying to keep faith with the shareholders by calling on

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them for just as little cash as possible. Their expenditures at the mine have been carefully made, and full value received for the money paid out.

During May, 1900, each drill in the mine averaged 83¼ feet of drifting, at a net cost of but $4.80 per foot. This speaks well for Capt. Trezona, and the class of miners he has secured. At present only three drills are running in the mine, but the other seven are available for use whenever required, and the number will probably be raised to 20 or 25, when the mill starts.

In addition to its mine buildings, the Mass company has about forty dwellings, of which the greater number are old houses, standing on the various mine locations, which have been repaired and rendered habitable.

The company has platted a townsite, known as Mass City, and this is in charge of Col. P. W. Scott. The town has grown like a weed. It is the terminus of the Copper Range, and has the Chicago, Milwaukee & St. Paul and Mineral Range railroads as well. Its strategic position seems unassailable, and barring a continued run of hard luck, Mass City is certain to become one of the considerable towns of the copper district. The Mass Consolidated company has profited to a considerable extent from the building of the town, and will be benefited thereby to a much greater extent in the future.

A traffic arrangement was entered into in 1899 between the Mass company and the Duluth, South Shore & Atlantic Railway, by which the latter built a forty mile branch of its line, at a cost of nearly $750,000, from Keweenaw Bay to Mass City. This line will handle all of the mine's freight, on terms advantageous to the Mass company. The easy grades secured for the new road allow a low rate on rock transportation, although the distance of forty miles is the greatest between the mine and mill of any property in the district. The mill site of the Mass is on Keweenaw Bay, an arm of Lake Superior, with nearly a mile frontage for sand-room, in deep water. The millsite has been christened Ogima by the Mass company, and Keweenaw Bay by the railroad company. The latter title is confusing, and Ogima should prevail. The millsite is between Newtonville and Assinins, a short distance south of the former, and is one of the best in the district. Being sheltered to a considerable extent, it can be used in receiving coal and other freight, which cannot be done at any of the mills located on the shore of Lake Superior, with the possible exception of the Mohawk and Wolverine mills, which are to be built on Traverse Bay, Lake Superior.

The foundation for the new mill, which is 90 x 210 feet in size, is in, but the structural steel, promised for August, is not yet here, on Nov. 27th. The delay in receiving material is likely to throw the completion of the mill beyond the spring of 1901. The equipment will be of the best throughout, and the mill, when complete, will cost, with its plant, nearly or quite $150,000. The mill will have founda-

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tions and floors for three stamps, but is to start production with one, which will be able to treat 500 tons or upwards daily. Solid foundations were easily secured, and the sandstone used for the sub-structure was quarried on the millsite.

In addition to the mill building proper, there will be a boiler house and pumphouse, and small carpenter and machine shops; also buildings for employees. The boiler house will be of wooden frame, with corrugated steel siding and roof, and will house two Stirling water-tube boilers of 200 horse power each. Ashes from the fireboxes will be dumped into an iron chute, and washed through a launder into the lake by the use of a hose. This is a small thing perhaps, but it will save the wages of two to four men who would otherwise be required to wheel the ashes out in barrows. It is the aggregation of small things, like this easy method of disposing of ashes, that has done much to cut milling costs squarely in two in this district, in the past twelve years.

Located near the lake is a pumphouse, in which will be placed a 16,000,000 gallon vertical pump, of Nordberg make, similar to the one which has given such excellent service at the Arcadian mill, and the one now building for the new mill of the Isle Royale. A well has been sunk in the pumphouse, and a tunnel is now being driven 300 feet under the bay. An intake will be provided by boring three-inch holes through the sandstone bed of the lake, into this tunnel, which is 4 x 6 feet in size. Another small tunnel connects mill, boiler house and pumphouse, and in this the water and steam pipes run, side by side.

The Mass will become a producer, as soon after the manufacturers will furnish the structural material and the machinery for the mill, as the erection and installation can be accomplished, but this will take months. All of the new mills of the district have been subjected to similar annoying delays.

The probable percentage of the Mass can only be guessed at, and one man's guess is about as good as another's. It can be made very high, or very low. The mine has some of the richest stopes ever opened in any Lake Superior mine, and some very lean ground. The tendency at all of the mines is unmistakably toward lower percentages at the mills, due to two reasons—the increased price of the product, and the decreasing cost of production. For these reasons it is improbable that the mill returns will be of the remarkably high average that the mine is unquestionably capable of giving with careful selection of rock. If there is more money in grinding up all the rich rock and much of the low grade stuff than in taking the former only, the management of the Mass will probably see the point. The important question is whether the mine will earn a profit, and not what percentage of ingot copper will be yielded per ton of lode rock stamped.

It is the opinion of the majority of the best mining men of the district that the Mass will make a profitable mine. The management is an economical one and the mines in the consolidation will be given.

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a fair trial for the first time in their history. The old Mass mine was notably rich, and the Ridge was a dividend-payer, under the management of Capt. S. B. Harris; but he was hampered by lack of modern equipment and inability of the owners to see that the future of the mine depended upon making betterments. The property is now equipped with machinery at mine and mill such as Capt. Harris never dreamed of in his wildest visions while at the Ridge, and is fortified by a treasury that would have staggered belief two decades ago. There is good reason to believe that the Mass will make a profitable mine.

MICHIGAN.

The Michigan Copper Mining Company was organized by Messrs. E. F. Conely and others, of Detroit, in June, 1898, and was reorganized, upon a basis allowing the raising of funds adequate for the opening of a large mine, by Cameron Currie and associates, on Jan. 5, 1899. It is a Michigan corporation, with 100,000 shares of stock of the par value of $25 each, all issued, on which $10 per share has been paid in. The number of shareholders on Dec. 31, 1899, was 592. The eastern office of the corporation is at 11 and 13 William street, New York City. The American Loan & Trust Company, of 53 State street, Boston, is transfer agent, and the Old Colony Trust Company, Ames building, Boston, is registrar of the stock. Annual meetings of shareholders are held on the first Tuesday of May in each year.

Officers of the company are as follows: President, John Stanton; secretary, J. Wheeler Hardley; treasurer, John R. Stanton: directors, John Stanton, Joseph E. Gay, J. Wheeler Hardley, John R. Stanton and Alfred M. Low, of Michigan. At the mine, Samuel Brady is superintendent: J. C. Thomas, mining captain, and S. H. Brady is clerk.

The realty of the Michigan company is very extensive, there being upwards of 5,000 acres of which the company owns either the mineral rights, the surface rights, or both, the greater part of the real estate being owned in fee simple. The Michigan company owns the properties formerly known as the Minnesota, Rockland and Superior, of which the two first named were important mines. The real estate holdings are located in Sections 1, 2, 3, 9, 10, 11, 13, 14, 15, 16, 17, 21, 22, 23, 24, 25, 26 and 27, of Town 50 North, Range 30 West. The main tract is very compact, having a width, east and west, of three miles, and a length, north and south, of 4½ miles. In addition to the main holdings there are four scattering tracts, west of the Rockland mine. The neighbors of the Michigan are Canal lands and the Mass Consolidated to the north; the Knowlton mine of the Adventure Consolidated, the Flint Steel, and Canal lands to the east; Canal lands to the south, and the National mine and mineral lands of the Jeffs Land Company to the west of the main portion of the property. The four isolated tracts consist of 80 acres in the west half of the southwest quarter of Section 9, just west of the village of Rockland; 80 acres in the south half of the northeast quarter, and 40 acres in the southeast quarter of the south-

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west quarter of Section 17; and 160 acres in the northwest quarter of Section 21, lying one-quarter mile west of the main tract and carrying the outcrop of Calico lode for a portion of its extent. The beautiful village of Rockland lies barely more than a half mile north of "A" shaft of the mine.

The Michigan company began business on Jan. 25, 1899, with cash on hand to the extent of $352,246.80, and liabilities of $2,648.43. The cash on hand was secured mainly by the sale of 32,965 shares of capital stock, which brought a net premium of $20,350 over the upset price of $10 per share. The balance of the capital stock of the Michigan Copper Mining Company was exchanged for title to the Michigan (Minnesota) and Rockland mines, and sundry other realty, together with cash on hand, amounting to $2,846.80. In the following financial statement, which is taken from the annual report of the directors and agent for the year ending Dec. 31, 1899—and which is one of the best and most comprehensive issued by any mining corporation doing business in the state—the figures show receipts and expenditures from the resumption of activity, in the summer of 1898, under the Conely-Jeffs regime, previous to the reorganization effected by Mr. Currie:

Gross receipts from all sources to end of 1899	$380,602.06
Gross expenditures to same date	246,559.16
Net cash balance on hand	$134,042.90

A detailed statement of expenditures is as follows:

Expended at mine in 1898	$ 28,738.43
Expended at mine in 1899	153,933.23
Total expended at mine to Dec. 31, 1899	$182,671.66
Real estate purchased in 1899	$ 56,569.12
Incorporation tax, listing, certificates, etc.	2,326.06
Salaries, rent, and sundry general expense	4,992.32
Total expenditures to Dec. 31, 1899	$246,559.16

The real estate investment included $40,000 paid to shareholders of the Rockland Mining Company to quiet title, the Michigan company having only tax titles, which were probably valid, but might have required considerable litigation to establish. The sum of $10,500 was paid for the lands of the Superior Mining Company. This tract added about 50 per cent to the area of the Michigan on the Calico and Minnesota mineral beds.

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The expenditures of 1898 were as follows:

Underground expense	$ 7,352.90
Surface expense	4,029.88
General expense	3,341.51
Exploratory work on Evergreen range	1,399.01
Construction account (including machinery).	12,615.12
Total	$ 28,738.43

The expenditures at the mine for the year 1899 were as follows:

Underground expenses	$ 64,954.41
Surface expenses (net)	20,688.43
General expense (including taxes for 2 years)	10,370.67
Construction account.	57,912.72
Total	$153,933.23

The construction account at the mine was made up of the following items:

Mine buildings	$ 32,472.57
Machinery and boilers	25,447.15
Total	$ 57,912.72

The following figures are from the sworn report of the company to the State of Michigan, under date Dec 31, 1899:

Amount of cash paid in on capital stock	$329,650.00
Amount paid in by conveyance of property	670,350.00
Amount invested in real estate	726,919.12
Amount of personal estate	146,171.91
Amount of floating debt	12,129.01
Amount due the corporation	

Of the various old mining properties now owned by the Michigan it may be said that the Superior is credited with a production of 283 tons 1,331 pounds of refined copper, all but a few tons of which was secured in the years from 1858 to 1869, inclusive, though three or four tons were scrammed out by tributors in 1876-79. The largest product secured from the mine was 51 tons 788 pounds, in 1864.

The Rockland lies next east of the old Minnesota, and was a mine of considerable promise, though the promise was never realized. It was set off from the Minnesota in 1853, and was closed in 1870, since which a little copper has been secured by tributors. It carries the easterly continuation of the Minnesota vein and the Calico lode now being opened by the Michigan. The old mine was opened mainly on

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the Minnesota contact vein, which was about two feet wide at that point. The Rockland has produced 3,105 tons 309 pounds of refined copper in all. It is also remembered by old miners as having been quite prolific in silver.

The old Minnesota mine, now owned by the Michigan, was easily the most famous copper mine of Lake Superior in the early days. In point of profits its only rival was the Cliff, while in the monstrous size of its masses of virgin copper it had no equal, though the Phœnix mine, in Keweenaw County, has since produced a somewhat larger mass. The mass that made the Minnesota famous was found in 1856. Its dimensions were 12½ x 18½ x 46 feet, and its weight was 527 tons. It required twenty men fifteen months, working with long-handled chisels, to cut this mass into pieces small enough for hoisting, and 27 tons of copper chips were made in doing this work. Many smaller masses, some of which ranged up to several hundred tons weight, were taken from this mine, and there is no question that it deserves the title of the richest mine ever opened. The Calumet and Hecla is a far more valuable mine, but no other mine opened has ever yielded such enormous quantities of copper from such small openings as were furnished by the best stopes of the Minnesota.

The Minnesota mine was discovered in 1847, through finding an Indian pit in which was a six-ton mass of native copper, that had been broken from its matrix of rock and raised on skids. The skids had rotted centuries before, and on the soil that had covered the nugget grew a hemlock tree, showing nearly four hundred rings of annual growth. The company was incorporated in 1848 and wound up in 1876. The mine was opened in 1848 and closed by the company in 1870, after which several hundred tons of copper were secured by tributors working above the adit level. The mine returned dividends of $1,820,000, from 1854 until 1876, the last dividend being paid in liquidation. The assessments levied amounted to $456,000. The period of prosperity of the mine was from 1854 until 1864, when dividends of large size were paid frequently. There was evidently a screw loose in the management of the mine, for in 1870, after the company gave up work, tributors secured 270½ tons of ingot copper, working without many of the conveniences that the company enjoyed, this product selling for $93,336.48, and as late as 1880, ten years after regular mining work was suspended, twenty-five tons of mass and barrel copper were taken out of the levels above the water line.

The mine was originally opened on the North Minnesota vein, a fissure running parallel with the formation. This outcrops just south of the Calico amygdaloid, now being opened by the Michigan, and at a depth of about 300 feet joins the main Minnesota vein. This fissure gave barrel copper and some stamp rock. The main vein of the Minnesota is essentially different from any other worked in the Lake copper district, and is generally called a contact vein. The copper was found usually in large masses and smaller nuggets, though with

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some stamp rock, in and between an underlying conglomerate and an overlying amygdaloid trap. The most plausible theory of its occurrence in this manner would seem to be that the overlying trap strata slid downward, leaving the adjoining faces of trap and conglomerate pulverized to such an extent that they were easily pervious to water, and with numerous cavities, into which the copper came by precipitation from above. As the sliding ceased, the superincumbent strata gradually pressed more heavily upon the underlying conglomerate, thus welding the copper originally deposited in small grains into the masses of varying size, the larger masses naturally being found where the greater cavities originally existed, after the sliding of the trap and the other strata above. This theory does not explain everything, but is the best the theorists have to offer at present, and seems decidedly plausible. A corroborative evidence is that the greatest masses and richest ground were found near the so-called counter-vein, a fissure crossing the contact vein transversely, and having a dip somewhat nearer vertical. The Minnesota is locally termed a conglomerate, by the miners, as the bulk of the copper was found in the conglomerate reef, that being the softer of the two strata, and therefore a better matrix for the deposition of the copper. Little seams of copper penetrated both foot and hanging walls in every direction, and beyond the zone of masses. It is possible that a considerable amount of good stamp-rock might be secured from both foot and hanging walls of the old workings, the mineralization penetrating both strata to some little distance beyond the points where masses were usually found. It is also probable—or perhaps it might be said certain—that a large amount of heavy copper, both masses and barrel work, would be found in securing such stamp-rock from the old stopes. The finding of hundreds of tons of heavy copper in the three upper levels, by tributors, who worked in this circumscribed area for many years, without the benefit of power drills and modern machinery, and with no mill to stamp their production of rock carrying fine copper, renders it practically certain that similar conditions will be found to prevail below the water-level. That there are probably thousands of tons of heavy copper, to say nothing of stamp copper, in the mine as opened, below the water level, seems a reasonable prediction to make, in view of the demonstrated facts. There are also the extensions of the lode both east and west, and the dip of the lode below the bottom of the old mine, to be investigated, and it is highly probable that something of value remains in them,

The gangue of the contact vein was mainly of quartz, epidote and calcite. The Minnesota had a little stamp mill, which was run when there was water, and the average return from this was about 4 per cent mineral, equivalent to 3 per cent ingot copper. This mill had a daily capacity of only forty tons, under the most favorable conditions, which were frequently lacking, the capacity of the mill being only one-tenth to one-fourteenth of that of a single stamp of the kind now used.

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The Minnesota had ten shafts, the deepest of which is supposed to have been put down nearly 1,300 feet, according to the maps of the underground workings of the old mine. Six of these shafts were sunk on the contact vein from surface, but the four in the center of the property were started on the North Minnesota fissure vein, which made into the contact vein at about 300 feet depth.

The Minnesota produced 17,352 tons 668 pounds of copper to the end of 1888, and has since yielded a few tons more to persistent miners, who got out copper a quarter century after the mine was abandoned and robbed, not by one, but by half a dozen sets of tributors, each of whom found some copper overlooked by those who had gone before. The largest annual product of the mine was in 1856—the year of the finding of the big mass—when 1,745 tons 714 pounds were secured.

If a tithe of the tales, told by old miners who worked in the Minnesota thirty years ago, are to be believed, there remain millions of dollars worth of copper in the mine. It is true that such recollections must be taken with a grain of salt, as the miner sees through the vista of backward years with a telescope that wonderfully magnifies mineral values, and any abandoned mine gets the name of having been rich; but in the case of the Minnesota there is reliable evidence corroborating the claims that the mine was abandoned through faint-heartedness, and not because it was worked out. In 1870, when the mine was closed, copper sold below 20 cents, for the first time. The earnings of the mine had been paid out to shareholders as rapidly as the copper could be turned into cash and the checks signed. Mine managers of thirty years ago had not learned that even the richest copper mine should carry a big cash surplus, for use as a balance wheel to furnish momentum to carry the property over a period of adversity, to which the richest mines are subject. At the time the Minnesota closed, the bottom levels were down to the limit of the hoisting power of the plant then used. A new equipment was imperatively demanded; copper was selling for less money than ever before; the mine was looking poorer than ever before—therefore the owners quit. The developments of the next few years are likely to prove that they were unwise in not going into their pockets, as the shareholders of the Quincy did in early days, when the bottom of their mine showed scarcely a single profitable stope.

The plan of operations of the Michigan company has been to open a new mine on the Calico amygdaloid, which outcrops 140 feet north of the outcrop of the Minnesota contact vein. The Calico was carefully inspected underground before the first shaft was started, this inspection below surface being rendered possible by an old crosscut running from the upper levels of the Minnesota mine. The inspection was satisfactory, and the work of opening the lode on a large scale was undertaken forthwith.

As previously explained, in the article on Adventure, there are two

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mineral belts in this district within the limits of the trap formation, these being the Evergreen belt on the south and the Minnesota belt on the north. Both of these belts outcrop on the Michigan tract, which has the underlay of the lodes to tremendous depths, due to its great area. The principal known metalliferous strata outcropping on the Michigan are at least eight in number, these being, in order from north to south, the Calico, the Minnesota North vein, and the Minnesota contact vein in the Minnesota belt; and the Knowlton, Mass, Ogima, South Amygdaloid, and an unnamed amygdaloid immediately following in the Evergeeen belt. It is more than probable that the two amygdaloids found near the bottom of the latter series are the Butler and Evergreen lodes, although they have not been actually traced to a junction with the same lodes on the Mass property. The strike of all the strata in the lower, or Evergreen belt, is much nearer north than at the Mass, showing that after passing south of the Mass property these lodes resume nearly the same strike as is shown, just east of the Mass and Ridge mines of the Mass Consolidated property, on the Adventure and Hilton mines of the Adventure Consolidated Company's lands. The Knowlton lode, the northernmost of the Evergreen series, outcrops about 1,000 feet south of the line of shafts of the old Minnesota mine. About 2,000 feet south of the present "B" shaft of the Michigan, an adit was driven in the south bluff, sometimes known as Peninsula Bluff, about a third of a century ago. This adit was started on the southern side of the bluff, and is driven a little west of north, penetrating the various strata at nearly right angles to their outcrops. The adit is about 300 feet in length, and has already cut one amygdaloid, supposed to be the Evergreen or southernmost copper-bearing bed of the Evergreen belt. It will be continued by the management of the Michigan for at least 600 feet northward, and in that distance will probably cut the other amygdaloids of the southern belt. The Evergreen, if that be the lode cut by the adit, carries some copper where opened—not enough to be called a good showing, but sufficient to warrant a little drifting, as the lode is notoriously bunchy at all points where opened to any considerable extent, and poor ground may turn into rich in a few feet, or vice versa. The old records of the Minnesota state that two shafts were sunk near this adit, to about 300 feet depth each, and these will probably be unwatered and examined, and if indications are favorable, some drifting may be done from one, or both.

North of the Calico there are known to be other amygdaloid outcrops which carry copper, but no work has been done on them and no opinion can be expressed of their probable value until they have been opened to some extent.

The Calico lode has been traced for nearly a mile, and opened upon to greater or less extent for nearly half a mile, by three shafts and their drifts. It has a strike of approximately North 65 degrees East, and a dip of 46½ degrees, as nearly as ascertainable, to the northwest. So far as opened it runs 5 to 12 feet wide, with an average width of 9 to 10

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feet. The lode "heaves" considerably in its dip, bringing the shafts in and out of the footwall, from level to level. There is also a marked sinuosity in the strike, accented somewhat by rolling surface, but the irregularity in this respect is much less than the heaving noted in the dip. The lode itself is a peculiar amygdaloid, ranging in character from nearly a trap to almost a conglomerate. It carries considerable felsite, and occasional patches of sandstone, apparently intrusive, but presumably not so. There is a large quantity of epidote, calcite and phrehnite, and the blending of dark colored melaphyr with the whiteish crystals of calcite, and the yellow and green of the prehnite and epidote, gives a peculiarly mottled appearance to the mass of rock, from which arises its name of "Calico"—a name that hits off the appearance of the rock very nicely, for chromatically it certainly resembles a bit of gaudy calico, with the colors a trifle run. The copper is found mostly in two or three feet nearest the footwall, though occasionally occurring in good patches on the hanging and in the center of the bed. The metal comes mostly in the form of shot-copper, which consists of small, rounded granules. Copper in this form is usually easily saved in the milling, even when quite fine. Some mass and barrel copper is found in the lode, the masses running small as a rule, the heavy copper being most common at the intersection of the lode with the numerous fissures, usually filled with clayey matter, which are found crossing the stratified formation. A little silver is also carried in the Calico. The Michigan tract has the outcrop of this lode for nearly one and a quarter miles, and owns the underlay for such stupendous depths that nobody would care to figure on the possibility of opening the bed to the northwestern boundary of the mine lands. The Calico outcrop is 140 feet north of the outcrop of the main vein of the Minnesota, and but a few feet north of the old "North Vein" of the Minnesota, on which the first shafts of that mine were sunk. The Calico is considerably broken as to its walls, merging into them by degrees rather than resting against them with a sharp cleavage. This is especially true of the footwall, and it requires sharp watching to tell the point of contact between lode-rock and foot, at many points. The Calico also has a tendency to split, this being noted between "B" and "C" shafts, where a seam of amygdaloid, known to the miners as the "Footwall Vein," is found a short distance under the apparent foot on which the Calico rests. This "Footwall Vein" apparently starts just east of "B" shaft, and at "C" shaft seems to be on the point of rejoining the main lode. Where this "Footwall Vein" exists, the Calico is very lean in copper, and the lode below is very rich, the latter having served, apparently, to drain the metal out of the Calico. It seems probable that the footwall stratum is merely a feeder, or stringer, though this point, like many others, is open to argument. The man who dogmatizes with regards to mineral-bearing rocks is putting himself on record to his own ultimate confusion. The Cornish miner is the only man who has this sort of thing down to perfection; his answer

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to all puzzling theories and disputed questions regarding copper is, "Where he is, there you find 'un." This, in the long run, is about all that the ablest theorist can advance with perfect confidence in the truth of his dictum.

The Calico is a strong lode physically, despite its conglomeration of minerals, and stands well without timber. It is also dry, though water began seeping through from the old Minnesota openings when the shafts on the Calico got below the water level of the latter.

There are three shafts opened on the Calico, of which "A" is the first and westernmost, lying about 1,000 feet east of the Michigan's west boundary line with the National, measured on the outcrop of the lode. It is located immediately back of old No. 4 shaft of the Minnesota, and is at present about 650 feet deep. Drifts have been opened both north and south on the four levels above, but at present the efforts of the management are in the direction of deepening the mine rather than opening it laterally. A four-foot drum, with 9x15-inch cylinders, handles the skips in this shaft, which is 6x18 feet inside of timbers, and has three compartments. There are two boilers of 100 horse power each, and a ten-drill Ingersoll-Sergeant air compressor, at this shaft.

"B" shaft is 985 feet east of "A," and is the principal shaft of the mine at present. It is about 750 feet deep, and is being put downward at the rate of 85 to 90 feet per month, by miners working in three eight-hour shifts. It is the pump-shaft, and is provided with a big Burnham sinking pump on the fourth level, this being one of four pumps of the same make recently ordered. It has 16x24 steam cylinders, with 16-inch stroke, and a 10-inch water end, with a 6-inch discharge pipe, and will raise 400 gallons of water per minute, from a quarter mile depth. It is of the same design as the pumps recently installed in the Tamarack, Osceola and Isle Royale mines, and which have given great satisfaction at those properties. The fifth level was reached in "B" shaft at the depth of 696 feet, early in November, 1900, and as this level is a hundred feet or more below the water level of the old Minnesota, the unwatering will be begun at this point. The old mine, nearly a quarter mile deep, and with a thousand feet of water in it, undisturbed for thirty years, will be unwatered by stages. A diamond drill is boring a hole across the 125 feet of rock intervening between the old mine on the contact vein and the new one on the Calico, from the fifth level. The water will spurt through this hole, when finished, under a heavy head, and will be forked out by the big Burnham pump. When the water in the old mine is down to the level of the drill hole, another drill hole will be put in from the sixth level of "B" shaft, a hundred feet lower, and this process will be repeated every hundred feet, until the old mine is drained. A crosscut will then be driven from the bottom of "B" shaft, under the old Minnesota workings, which can then be examined and reopened as desired. By following this plan it will be possible to retimber the old mine, as may be required, from the bottom upward,

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in safety. The attempt to have retimbered from surface would have been dangerous, though it is possible that it may be necessary to retimber one of the old shafts from surface down, but this will depend on the condition of the shafts. If they are clogged with a few hundred feet of waste-rock and old timber, the debris will have to be removed from the top. Capt. W. E. Parnall, of the Tamarack and Osceola mines, who spent nearly two years unwatering and cleaning out the old National mine, next west of the Minnesota, can give some emphatic opinions on this subject. The tributors have a way of throwing all odds and ends into the water-filled shafts below them, to the great discomfort of the housecleaner who follows in their untidy footsteps. The Minnesota was connected with the National mine, to the west, between the 60 and 70 fathom levels, but the latter company, when last working, sued the Minnesota for damages, and the hole was damned. This gives the Michigan a higher water level to pump from at the start, but will prevent draining the upper levels of the National for the future. The upper levels of the Minnesota and Rockland are connected, so that the Michigan must pump from the upper workings of the latter mine also, but as the Rockland is a continuation of the Minnesota, and will be given careful examination at the same time as the Minnesota, this is no particular detriment. A dam can easily be built to hold back the Rockland water from the Minnesota openings, if desired.

A four-ton mass of native copper was recently found in a crosscut put south on the first level at a distance of 536 feet east of "B" shaft. This is a large enough chunk to establish the status of the Calico as a mass producer, in addition to being a stamp-lode. The formation is more disturbed in the ground opened by "B" shaft than is the case to either the east or west, but seems to become a trifle more regular with depth. The shaft has three compartments, and is the same size as "A" shaft inside timbers. A single four-foot Lidgerwood drum is being replaced by a Webster, Camp & Lane hoist with two drums six feet in diameter, calculated to hoist from a quarter mile depth. There is a two-stage Norwalk air compressor of 12-drill capacity, and four boilers of 100 horse power each. The location of "B" shaft is immediately behind old No. 6 shaft of the Minnesota.

"C" shaft, as yet the easternmost, is 1,353 feet east of "B," and at present is not sinking, attention being concentrated on the deepening of the two older shafts. It is now 340 feet in depth, and fitted with a good plant on surface, this including a Webster, Camp & Lane hoist with 6-foot drums and 13 x 15-inch cylinders; a six-drill Rand compressor and two 100 horse power boilers. This shaft was started on an up-raise from a continuation of the old Rockland adit, and three tons of mass and barrel copper were found on cutting through the lode. The formation at "C" shaft is more regular than at "B," and very much the same as at "A" on the extreme west of the property. The shaft contains a more uniformly good showing of copper ground, from top to bottom, than either of the two deeper shafts.

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"D" shaft will probably be sunk from the bottom of a 25-foot pit opened in the Calico on the Rockland property, about a quarter mile east of "C" shaft, though the location of the new shaft has not yet been definitely settled.

The Michigan is now working about 65 men. The force has been larger in the past, but to date fully a mile and a quarter of levels have been opened on the Calico, and the management is bending every energy toward unwatering the old Minnesota. There is also more than a quarter mile of new shafts sunk, and nearly 500 feet of crosscuts run—a large amount of work, and which will compare very favorably with the results accomplished at any new mine in the district in the same length of time. Drifts have been opened both east and west on all levels of both shafts. The work has been skillfully done, at a very reasonable cost. Superintendent Brady has been attacked in print because he wears a business suit of clothes and lives in a comfortable house built for him by the company; but inspection of the mine he has opened, and of his cost-sheets, shows that an occasional "biled shirt" is not necessarily incompatible with executive ability as a mine manager. For 1899 shaft-sinking cost an average of $15.03 per foot; drifting averaged $5.86 per foot; and crosscutting cost $5.27 per running foot. At this rate stoping will be done for $5 or less, per fathom. These figures carry their own commendation, to practical mining men.

On surface the Michigan has well-built and well equipped shops, a dispensary, office building, barns and nearly 30 dwellings, all new or thoroughly rebuilt. The near proximity of the very pleasant village of Rockland relieves the company from the necessity of housing its entire working population. This same little village of Rockland is a town that would surprise the persons who imagine the copper district to be a region of perpetual snow, where the aurora borealis and the midnight sun are the principal phenomena of nature for at least nine months yearly. It is a fact, and not a boast, that the crops raised from the numerous fine farms around Rockland average a larger yield, per acre, than the farms of the best agricultural districts of southern Michigan. Three tons of hay, and 300 to 400 bushels of potatoes to the acre, are not uncommon. Roots and cereals of all kinds ripen to perfection, apples, plums, pears, cherries, and the smaller fruits, flourish with a luxuriance unparalleled in any but the most favored sections of the northern states. Rockland is a veritable garden, from May till September, and it is but a matter of time until all the fat acres, tributary to it for many miles in all directions, will be under the plow, or planted to the fruits that luxuriate there.

Practically half a mile of water mains have been laid, to furnish feed-water for boilers and fire protection to the mine location.

The Chicago, Milwaukee & St. Paul railway runs parallel with the shafts of the Michigan, and but half a mile distant from them. The Copper Range railroad has its southern terminus at Mass City, five

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miles east of the mine, the intervening territory having easy grades and being suitable for railroad building at reasonable cost. The Mineral Range branch of the Duluth, South Shore & Atlantic Railway from Newtonville is about the same distance from the Michigan.

A mill test of 1,000 tons of rock from the Calico lode was made at the Atlantic mill in June, 1900, and gave returns of better than one per cent mineral. The rock was taken from the dumps just as it came from the mine openings, without attempt at selection. Under these circumstances the showing was exceptionally good, and seems to settle the controversy as to whether the Calico is or is not apt to prove a paying stamp-lode. Few of the best amygdaloid mines of the district could give a better return than was secured at the mill-test of the Michigan, on rock taken in the same manner—that is, from all openings as driven, without stoping. Stopes would naturally give a higher average grade of rock, as they are opened only in the better stretches of ground.

The Michigan owns a millsite at Ten-Mile Point, Lake Superior, which is ten miles east of Ontonagon. This could be readily reached by a railway with easy grades from the mine, but there are serious disadvantages in using that location, chief among which are the shallow beach, which might eventually cause trouble in disposing of sands, and the lack of a harbor, desirable for the receipt of coal and general freight. Three other millsites have been under consideration, but so far no announcement has been made, and it is probable no decision has been reached. With three railroads anxious to get the business. the Michigan will obtain the benefit of low freights, in case it does not build its own railroad.

For the building of a mill an assessment will be inevitable. It will probably be made $2 or even $3 per share. The management does not see the object in spreading the misery over several successive levies though the assessment may be called in installments. No announcement as to a forthcoming assessment has been made by the management, but it will be a necessary precursor to the mill that the Michigan will soon need.

VICTORIA.

The Victoria Copper Mining Company was organized on Jan. 23, 1899, under the Michigan laws, with a capitalization of $2,500,000, divided into 100,000 shares of the par value of $25 each. The stock is marked $7 per share paid in, and of the amount raised, $350,000 was given for the properties in the present consolidation, and $350,000 was placed in the treasury as a working fund.

Officers of the company are as follows: President, Hon. Thos. B. Dunstan, of Hancock, Mich.; vice-president, Calvin Austin, of Boston; secretary, treasurer and transfer agent, James P. Graves; directors, Thos. B. Dunstan and Fred H. Begole, of Michigan; Calvin Austin,

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Fred H. Williams and Wm. F. Humphrey, of Boston. The principal office of the company is in room 539, Stock Exchange Building, Boston, Mass.

At the mine Capt. Thos. Hooper is superintendent, and the title is no empty honor with him. He personally superintends everything doing or that has been done at the mine. He is his own mining captain, master mechanic, mining engineer and architect. If there was a mill in operation he would probably superintend that also, as he is an expert at milling, being the only man who ever made money running the Nonesuch mine, on which various sets of owners and operators have lost a million or so dollars in the past third of a century.

The present Victoria consists of a tract of approximately 2,300 acres, located in Sections 19, 20, 29, 30 and 31, of Town 50 North, Range 39 West, and Sections 24, 25 and 36 of Town 50 North, Range 40 West. The tract has an extreme width, from east to west, of two miles, and an extreme length, from north to south, of 2¾ miles, with an extreme length, on the axis of the tract, which is northeast and southwest and a little north of the strike of the formation, of almost four miles. The property lies west of the Ontonagon River, and is at present the westernmost active mine of the Lake Superior copper district. It has for neighbors the West Minnesota mine and undeveloped lands on the north; the National mine and undeveloped mineral lands on the east; undeveloped mineral lands on the south, and the Devon mine and undeveloped mineral lands on the west. The tract is practically all on the mineral belt, only 100 acres or so overlapping on the Eastern Sandstone. The nearest active mine is the Michigan, less than three miles northeast, and Rockland is the nearest village.

The following figures relating to the Victoria's finances are from the sworn report to the State of Michigan, under date Dec. 31, 1899:

Amount of cash paid in on capital stock	$700,000.00
Amount paid in by conveyance of property	.....
Amount invested in real estate	370,030.61
Amount of personal estate	300,735.91
Amount of floating debt	.....
Amount due corporation	.....

The number of shareholders on record on Dec. 31, 1899, was 796.

Following is appended the financial statement of Dec. 31, 1899, as returned to the shareholders at the last annual meeting:

Receipts.

From capital stock	$700,000.00	
From interest	7,607.89	
From rents	489.28	$708,106.17

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Expenditures.		
Real estate	$370,030.61	
Plant	29,474.22	
Reopening mine	5,807.04	
Supplies	7,416.65	
Mining expense	9,244.67	
Taxes	1,084.53	
Surface expense	6,006.79	
Organization expense	2,926.10	
Legal expense	500.00	
Water power expense	1,808.13	
General expense	9,962.39	$444,261.13
Balance on hand Dec. 31, 1899		$263,845.04

The balance, or surplus shown, is in cash, the supplies on hand at the mine not having been added, as is usually done in showing the surplus of a corporation at the end of the year. The figures show that the Victoria spent only $74,230.52 for all purposes in its first year's operations, and started its second year with almost exactly three-fourths of its original surplus intact. The statement at the close of 1900 will probably show the Victoria to have the largest surplus, from the original organization fund, without reinforcement by subsequent assessments, of any of the new mining companies of the district, irrespective of the amount of surplus originally provided them. The favorable financial showing is due in part to the considerable time required in unwatering the old mine and getting it in shape for new work, but in no small degree, as well, to the rigid economy practiced in every detail by the Victoria management. A great deal of work has been accomplished at the mine in the past two years, and despite the many difficulties encountered, in the way of bad roads, non-existence of rail facilities, and complete lack of machinery and buildings upon resuming work, the results have been reached at a cost certainly as low as has been secured at any other new mine in the district, and much lower than in the cases of most new or reopened mines. The management is certainly securing a full dollar's worth for every dollar spent.

The Victoria is credited with a production of 186 tons 1,279 pounds of refined copper, of which 166 tons were produced before 1856. A little copper has also been mined from some of the other properties now included in the Victoria lands, and a little has been taken out by tributors, so that the mine probably returned between 200 and 225 tons of ingot copper, in all, previous to the resumption in 1899.

The Victoria was the site of the first copper mining of historic times, in the Lake district. A large mass of native copper, weighing upwards of five tons, now resting in the National Museum, at Washington, formerly laid on the northern bank of the Ontonagon river. It was seen by several of the Jesuit fathers who explored Lake Superior in the seventeenth century, and on the strength of its existence

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a mining company was organized in London in 1770, and mining was begun on the Victoria under direction of Alexander Henry, of Sault Ste Marie, an early pioneer of Lake Superior, in 1771. The miners drove an adit for some distance through clay and sandstone, but in the following spring the adit caved in, and work was abandoned, and it was more than seventy years later before a pick was again driven in search of copper on the southern shore of Lake Superior.

The history of the Victoria up to the time of the present organization is one of misdirected effort, mistaken financiering and poor judgment all around. The bad management was accentuated by misfortunes of great variety and spectacular nature. The mine was first opened in 1849, as the Cushin. A line of Indian pits was traced along the outcrop, and in one of these was found a mass of native copper weighing nearly a ton, and similar but smaller masses were found later in nearby pits. The Forest Mining Company was organized in 1850, and reorganized as the Victoria Mining Company in 1858. The Forest company spent $100,000 and the Victoria Mining Company expended $80,000 above the value of the product secured. The first stampmill of the mine was burned by a forest fire, which wiped out nearly all of the surface improvements. To guard against a repetition of this disaster, the new mill and several other buildings were erected in a clearing near the bank of the river, but shortly after their completion a flood of unparalleled severity swept away the mill and everything else in its path. A third mill was erected about 1870, and it was planned to run this with water pumped from the mine, but the scheme was not a success. A big windmill was then set up to pump the water for the mill, but that was also a failure. The Victoria has therefore suffered considerable injury in the past from the three elements of fire, wind and water.

The mine was operated regularly, according to the crude methods in vogue in the early days, from 1850 until 1855, and thereafter by spasms. The attention of the successive managements was so effectively taken up by the numerous troubles on surface that little was accomplished underground, after 1855, until the present company assumed control. The present holdings of the Victoria Copper Mining Company include not only the old Victoria mine, but also the Glenn, Shirley, Sylvan, Oneida and Arctic properties. These latter were all set off by the old Forest and Victoria companies, and have again been rejoined to the parent tract by the present owner. The mine was reopened by Capt. Hooper, the present superintendent, in 1881, but after pumping out the shafts he found the underground workings in such shape that a large expenditure would have been required for cleaning out and retimbering before copper could be secured, and lacking the capital to perform this work, Capt. Hooper allowed the mine to fill again.

The Victoria is located on a high and tremendously steep hill rising from the west branch of the Ontonagon. Notwithstanding the

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height of the hill, the surface of the rock formation is covered with a heavy drift, of sand and clay, and this overburden renders explorations tedious and costly. A diamond drill has been in regular use during 1900, probing the various strata north of the mine openings. The lode on which the mine is opened was known originally as the Forest, but as the formation was proved later, on the eastern bank of the river, three or four miles from the Victoria, it came to be the accepted opinion that the Forest lode was the western continuation of the Evergreen amygdaloid, the underlying or southernmost copper-bearing bed of the Evergreen belt. A crosscut has been sent several hundred feet north from the mine, without finding anything of value, but crosscuts to the south have shown a number of cupriferous amygdaloids. The recent developments at the Victoria point to the conclusion that the Forest lode is not the Evergreen, but the Knowlton or Mass amygdaloid, presumably the former, as the barren zone immediately to the northward is much like that intervening between the north and south belts of mineralized amygdaloids as determined at the Michigan, Mass and Adventure mines, lying northeast of the Victoria, while the copper-bearing strata already located south of the Victoria shafts bear a strong resemblance to the parallel amygdaloids of the Evergreen belt. Crosscuts from the mine have shown an underlying amygdaloid, rich in epidote, this being separated from the Forest lode by only six feet of trap, where opened by the crosscut run south from a point just west of No. 2 shaft. This epidotal amygdaloid is well mineralized for four or five feet along the footwall, and pieces of native copper weighing up to 50 pounds were taken from the lode in the width of the crosscut. A peculiarity of the bed is that the copper is found mainly on the foot and the epidote principally on the hanging wall. Lying under this lode is about 60 feet of trap, then a six-foot amygdaloid, which also shows much epidote and allied minerals, with some stamp-rock. No less than three cupriferous amygdaloids have already been located south of the Forest, on which the mine is opened, while none have been found for six hundred feet north. Although the strike of the formation at the Victoria would indicate the lode on which the mine is opened to be the Evergreen, the evidence of the stratification is emphatic that the Forest lode is really the northernmost of the Evergreen belt, which would be the Knowlton, unless that bed has come to an end between the Michigan and the Victoria properties, a distance of only three miles, which is improbable, though not impossible. An exploring shaft has been sunk about 40 feet on an amygdaloid outcropping some 200 feet south of the Forest lode, but though carrying a little copper, the showing was not a promising one. Future developments of the Victoria evidently lie to the south, or else to a sufficient distance north of the present shafts to strike the Minnesota series of copper-bearing beds. An amygdaloid called the Glen Creek was opened in October, 1900, and while insufficient work has been done to warrant the expression of opinion as to its value, the showing in the bottom of the shaft is quite encouraging.

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The Forest lode—for such it must be called until thoroughly identified with some one of the strata to the east—is an amygdaloid running 6 to 20 feet in width, where opened. It is not only irregular in width and rolling in its dip, but is bunchy in its copper contents, and extensive opening will evidently be required to determine the real value of the lode as a stamping proposition. The strike of the Forest is about North 69 degrees East, with a dip averaging 70 degrees to the northwest. The strike of the lode gives about a mile and a half of the outcrop to the Victoria, with a possible depth of several miles on the company's lands.

Work was resumed at the Victoria on March 1, 1899. Several months were required in unwatering, securing machinery and erecting shelter for it. No machinery remained on the location, and of buildings, only the frame of one house was standing. The bad roads complicated matters, and one of the first requisites was the improvement of the main road to the Ontonagon river. This thoroughfare has been put in good condition, and a wagon road built to the falls also. There was no bridge across the river, and machinery and supplies were ferried across on a flatboat. After the unwatering of the mine it was found that the old timber was too rotten for use, and that the adit level had caved in for some distance. The work of retimbering, cleaning out the debris, reopening the adit, installing and housing machinery and erecting mine buildings and dwellings took nearly the entire year, though the shaft selected for the principal mine opening was cut down and straightened, and a little crosscutting, sinking and drifting done underground, and about 250 feet of trenching and some test-pitting accomplished on surface in 1899. The real work of extending the mine openings has been accomplished during 1900, and has been pushed systematically and effectively. For the year 1899, underground opening consisted of only 110 feet of sinking, 289 feet of crosscutting and 302 feet of drifting. For the first six months of 1900 about 2,000 feet of opening was done underground, and in October about 600 feet was drifted, or at the rate of nearly two and a half miles per year, which is good work.

Numerous crosscuts have been driven, mainly to the footwall. These crosscuts are between shafts 1 and 2, and between 2 and 3 on the first level; at No. 1 shaft and between shafts 1 and 2 on the second level; between 1 and 2, between 2 and 3, and at No. 4 on the third level; and at No. 1, at a point just west of No. 2, and between Nos. 3 and 4 on the fourth level. The main crosscut to the north was abandoned, in October, 1900, after driving 700 feet without cutting anything of value, or even of promise.

The shafts are four in number. No. 1 is the easternmost; No. 2 lies about 240 feet westward; No. 3 about 250 feet west of No. 2, and No. 4, the westernmost, is nearly 300 feet beyond No. 3. This gives nearly 800 feet of lode proved by shafts, in addition to which the east drifts from No. 1 and the west drifts from No. 4 have opened sufficient ground to prove a length of about 1,000 feet on the lode. It

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is very evident from the appearance of the old mine that no engineer ever set foot in it, and that a transit was unknown to the men who laid it out—if such a term can be used in connection with a mine that was opened by rule of thumb, and not a very accurate thumb at that. The old mine was opened with levels ten fathoms apart, or what passed for that, the depths between levels varying from 55 to 66 feet. Capt. Hooper found it necessary to take the spinal curvature out of No. 2 shaft, when that was selected for the main working shaft of the mine, and also widened a number of the old drifts, which were too narrow to permit the use of tram-cars. No. 2 shaft has been given permanent timbering, with a good skip track, and rails have been laid in many of the levels for tram-cars, a portion of this track being permanent, and part temporary. Very little stoping was done in the old mine, this having been confined mainly to the two upper levels, in the neighborhood of No. 2 shaft. A new shaft, which will probably be known as No. 5, was started early in November, 1900, about 1,100 feet west of No. 2. The old shafts had caved in, and as they were sunk vertically until the lode was reached, their direction was changed to a constant angle by uprises from the junction of vertical and inclined sections. In cutting down No. 2 from the adit to the third level, considerable barrel work and good stamp rock was found, in what had been the footwall of the old stopes.

No. 2, the main shaft, and the only one fitted with permanent hoist, is 8 x 12 inside of timbers, with two compartments. It is now about 500 feet deep, and levels below the fourth are opened 100 feet apart. The lode averages about 8 feet wide and carries some barrel work, but mostly stamp rock. In the bottom of the mine the rich ground encountered in the extreme eastern ends of the drifts on the 4th, 5th and 6th levels is making west quite rapidly. In the Calumet district the copper courses make to the eastward as a rule. The pitch of this copper course to the west is decidedly encouraging to the Victoria management.

On surface at No. 2 there is a substantial frame shafthouse, 32 x 34 feet on the ground by 45 feet high, with an ell 16 x 36 feet. The engine and boiler house is 24 x 58 feet, with an ell 24 x 28 feet, the whole being of wood, on stone foundations, with steel roof. The hoist has 12 x 20-inch cylinders and a 5-foot drum with face of 6 feet 9 inches, capable of hoisting two skips, carrying one and a half tons each, from a depth of about 1,000 feet. There are two boilers of about 125 horsepower each, also a portable boiler and two 12-drill compressors, one old and one new. There are thirteen power drills, which number will be increased. Wood is burned for fuel, and in view of the great amount of available standing timber on the company's extensive real estate holdings, and the lack of rail communication, wood is a much cheaper fuel than coal.

No. 3 is used as an air shaft, and it has been decided to abandon because too close to No. 2. It will be replaced by the new shaft,

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No. 5, which may be known as No. 3, in the permanent naming of the shafts.

In the way of buildings the Victoria has a considerable number, made of a great variety of materials, and constructed at surprisingly low cost. A combination carpenter shop and warehouse is 24 x 72 feet in size. The frame blacksmith shop and machine shop is 20 x 52 feet in size, with wings 8 x 30 feet. There is a stone dry-house for miners, a log barn, and a frame boarding house and office, 27 x 64, two stories and attic, with an ell 10 x 37 feet in size. There is a frame schoolhouse 19 x 41 and nearly 25 dwellings; mostly of logs. The machine shop is run by a 12-horse power engine, and is furnished with a small outfit of tools, with which the management has managed to get along very nicely. The big lathes and planers will come after the mine has demonstrated its ability to run at a profit.

As the Victoria is located on top of a tremendous hill, water is precious, and a storage cistern 10 x 16 x 28 feet has been constructed, and into this the mine water is pumped, and used for the boilers. A well has been dug and housed over, to furnish potable water for the people living at the mine. The force at the present time is 90 men. During the present winter efforts at the mine will be concentrated as largely as possible upon underground work. The mine will ship its first production, under the present management, early in December, 1900. This will consist of about twenty tons of mass and barrel copper, secured in opening the mine.

It was expected in 1899 that the Mineral Range extension to the Mass mine would cross the river to the Victoria, but the road has not been built west of the Mass. It can be extended to the Victoria, though at considerable cost, owing to the river and the high hill, when the mine is ready to feed a stamp mill.

The Victoria has an inexhaustible supply of fine building stone on its lands, near the river. This is not of the handsome color which has made Lake Superior brownstone and redstone famous, but is of fine grain, well suited for all ordinary building purposes, and easily quarried in large sized blocks.

The Victoria possesses a valuable asset in Glenn Falls. These are located in the West Branch, the principal affluent of the Ontonagon River, about three miles west of the point of junction of the two streams. The falls have been examined carefully by competent hydraulic engineers, who estimate that a minimum of 4,000 horsepower can be secured, at the low stage of water, in August, with a forty-foot head. The stream drops 73 feet in the course of three-quarters of a mile, and nearly 150 feet in a mile and a half, by a series of small falls, between which are numerous rapids with sandstone bottoms. An offer of $100,000 for this water power and adjoining realty has been refused. There are two plans of development available, one of which is to build a steel-pipe penstock along the river bank, the other being to tunnel through the sandstone for half to three-quarters of a mile. The latter

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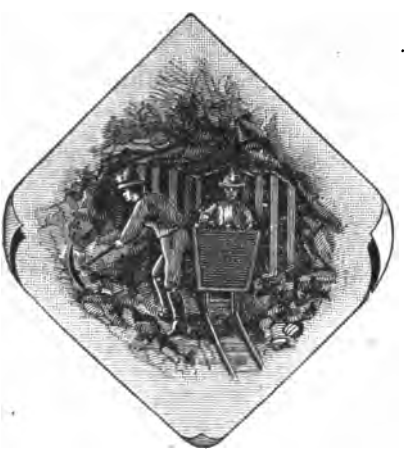
plan would require the heaviest initial outlay, but would give the best results in the end. This is the finest water power in the district, and as power is used lavishly at the copper mines, is certain of ultimate development to the extent of its possibilities.

There are new mining properties in the district making a better showing than the Victoria—and also properties making a much poorer showing; but whatever may be the ultimate outcome of the efforts now making to open a paying mine, the shareholders can have the comfort of knowing that not a dollar is being wasted, and that a careful management is bending every energy toward opening a profitable mine, and meanwhile is watching the strong box with exceptional vigilance.



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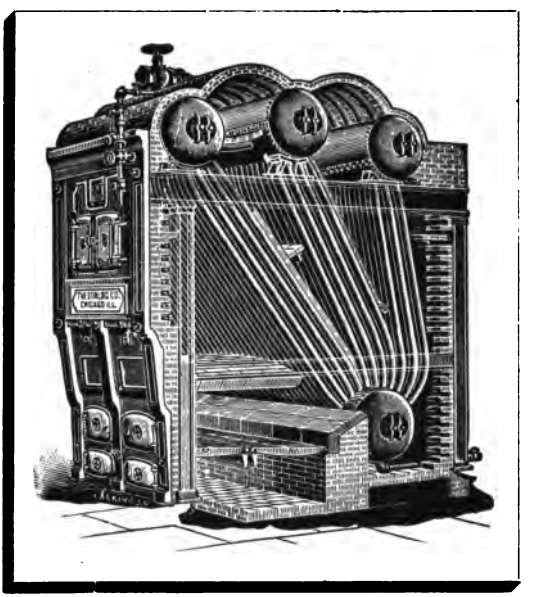

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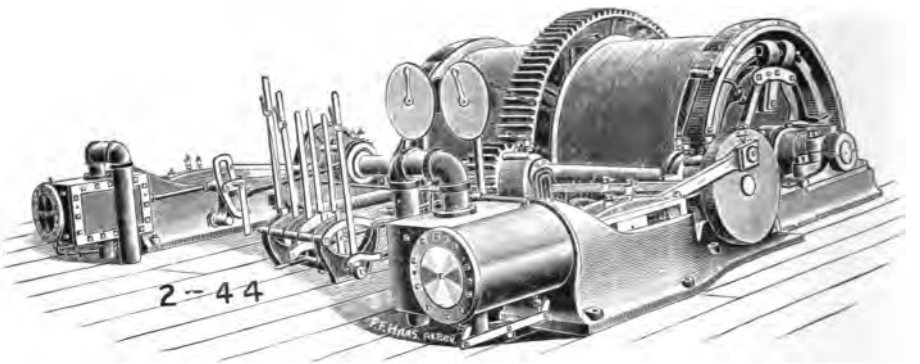

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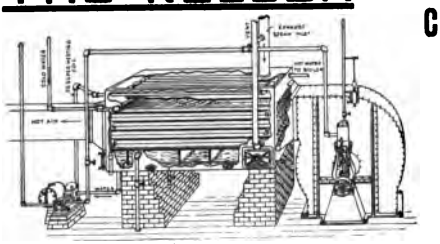

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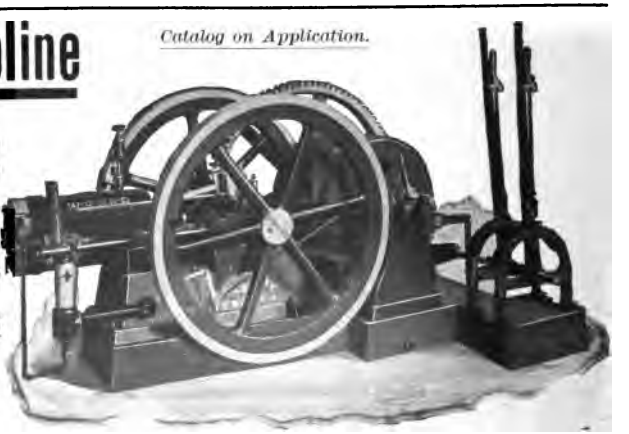

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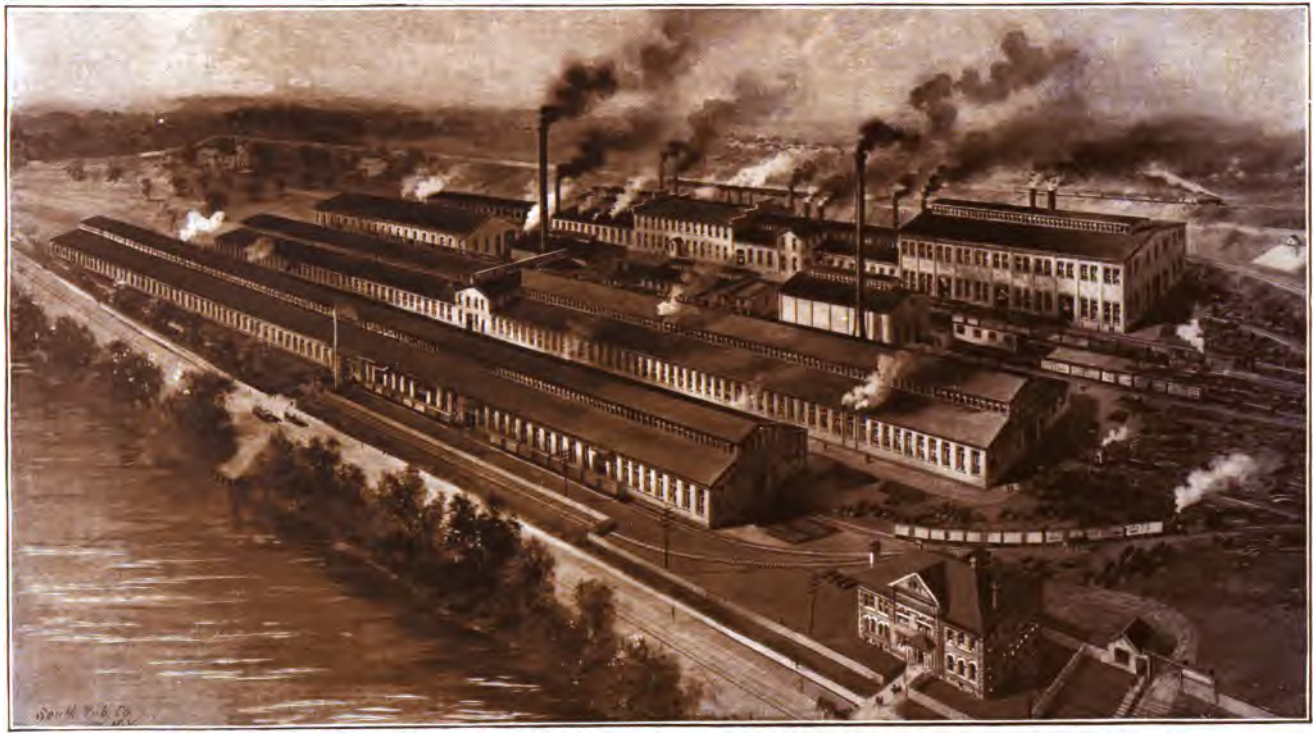

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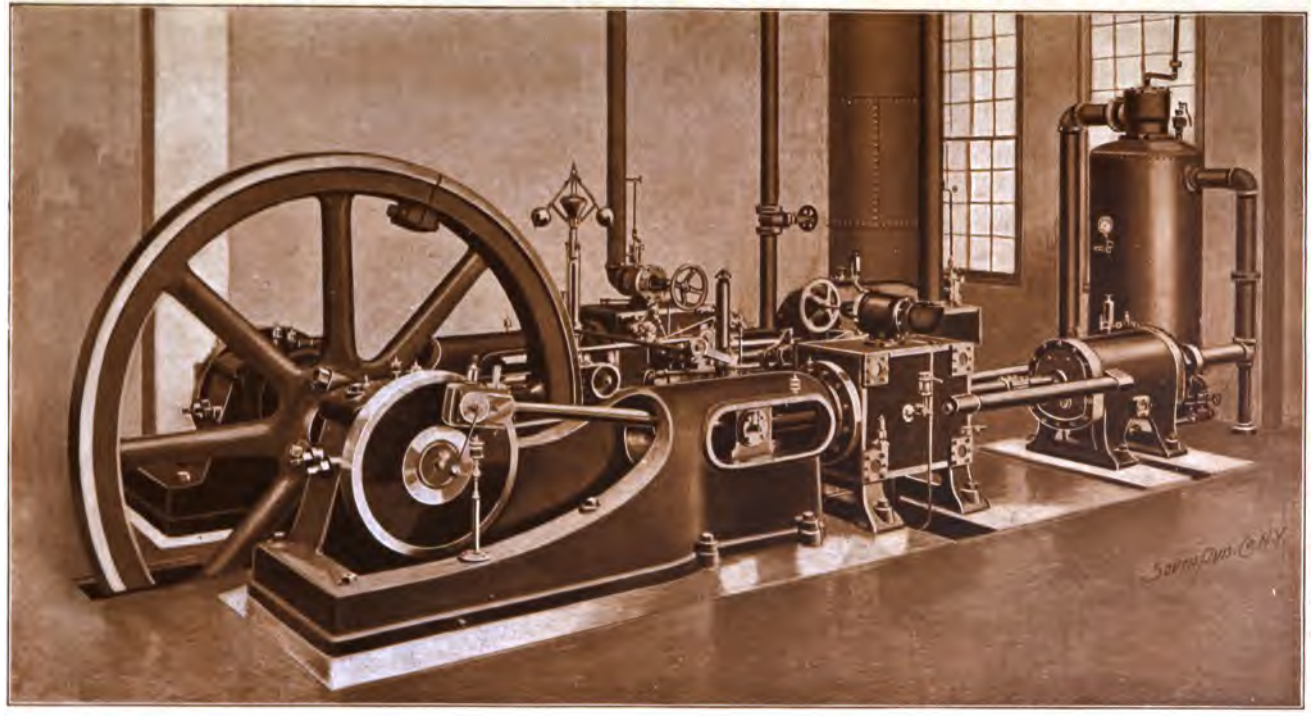

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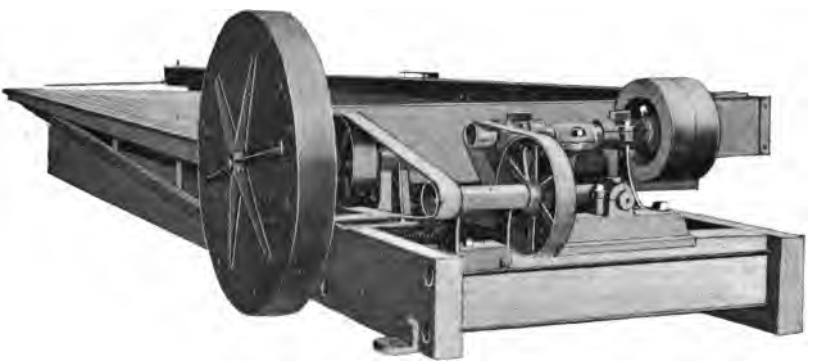

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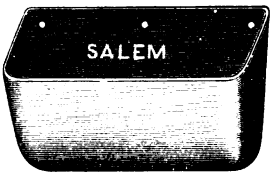

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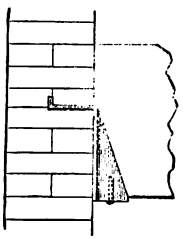

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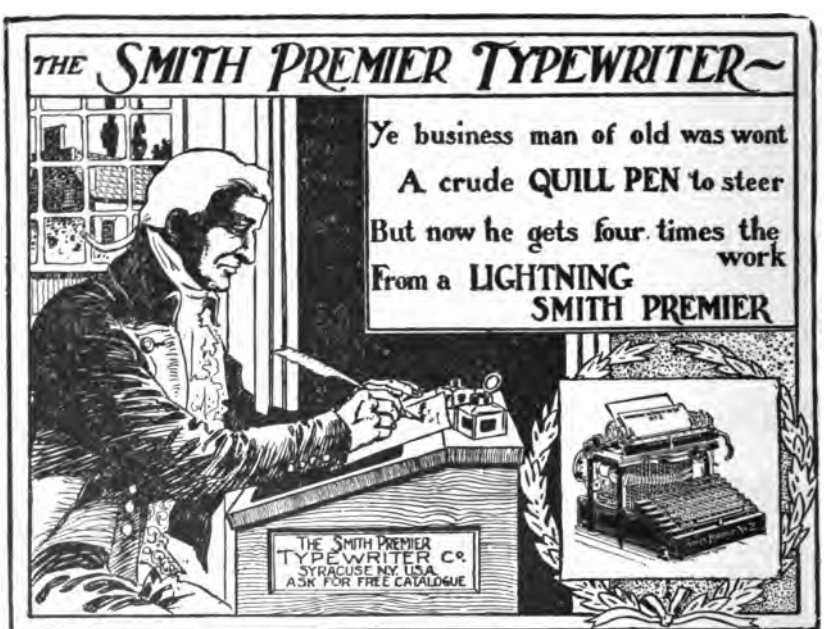
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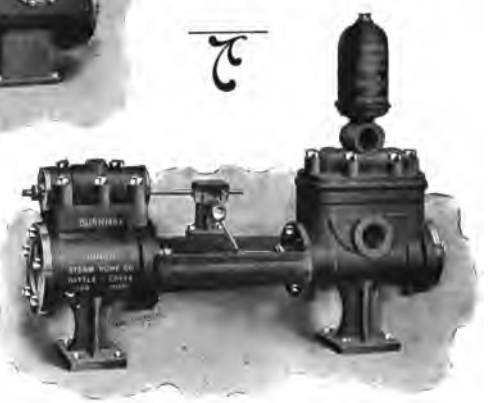

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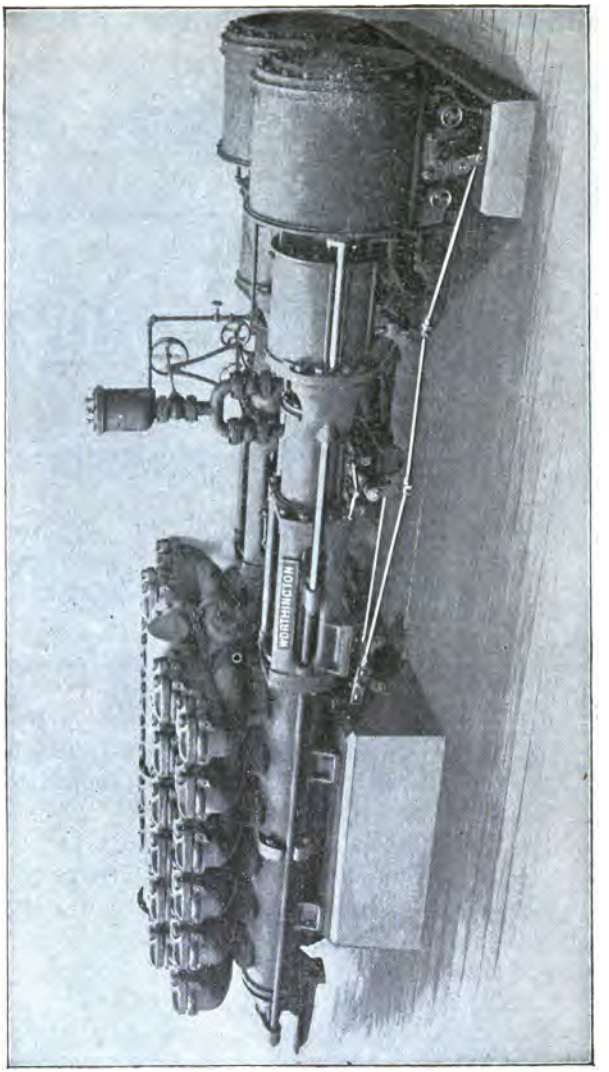

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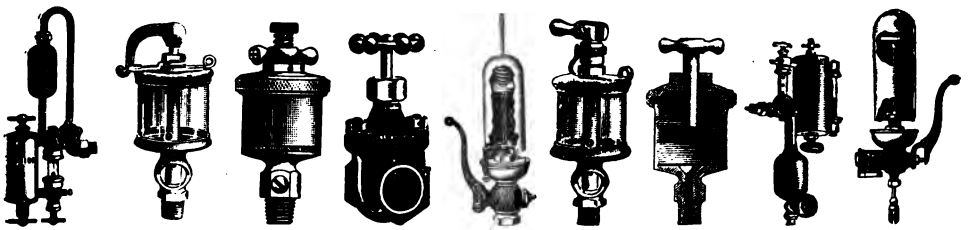

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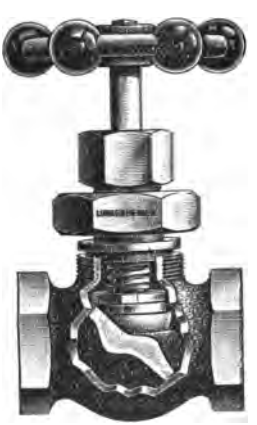

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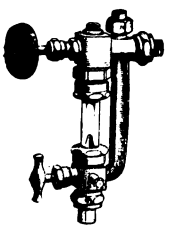

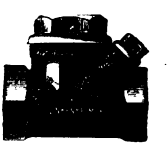

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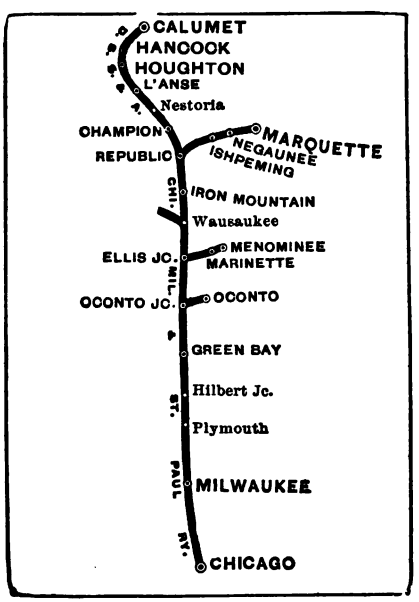

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